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The sewerage of Rio de Janeiro, Brazil, has been carried out by the Rio de Janeiro City Improvement Co., a London concern, with a capital of about $6,000. The original contract between the government and the company was made in 1857 for 90 years for draining the city, containing at that time 14,500 houses. As important suburbs sprang up a further contract was made in 1876 to extend the company's system, and the number of houses now drained and returned for revenue is about 35,000. New capital amounting to $787,000 is to be issued for finishing the works for draining additional suburbs, and which the company has agreed to drain under contracts with the government of the United States of Brazil, made Sept. 30, 1890. These works are already in an advanced state, nearly all the materials having been paid for and deposited in the city ready for use.

The report of the Railway Administration of India for the past year shows an apparent loss of $5,700,000, but if the interest on the lines under construction be excluded, the net loss is only $3,206,000. This unfavorable result is due to the heavy fall in exchange. This state still has to pay 4 4-5% on the capital raised by the guaranteed railway companies, whereas loans could now be raised at about 3%. The amount of rupees remitted to England to pay the sterling interest charges is, owing to the fall in exchange, equivalent to a payment of interest of over 7 3-5% on the capital raised, converted at par. Had silver remained at par the guaranteed railways would have shown in 1891 a surplus of $2,000,000.

Tracklaying for the first six months of 1893, according to figures collected independently by the "Railway Age" and "Railroad Gazette," shows, as was to be expected, a considerable decrease from the similar period of 1892. Our contemporaries vary considerably, however, in their figures; the "Railway Age" giving a total of 1,015 miles laid on 95 lines in 30 states, and the "Railroad Gazette" 896 miles laid in 34 states, a difference of 119 miles. It is probable that both totals will be somewhat changed by the final revised figures. Taking, however, the larger of the totals, and remembering that the ratio of the mileage of new railway built in the first half of the year is to that built during the last half as one is to two, we have about 3,000 miles for the total probable tracklaying of the year. This will bring the mileage of new track laid in 1893 below that of any other year since 1878, with the possible exception of 1885, when 3,000 miles were laid.

A new trainshed will be constructed by the Boston & Maine R. R. at Boston, Mass., in connection with the other improvements which it now has in progress there. It will be of brick, with an iron truss roof supported by columns, and will accommodate 17 tracks. It will be 528 ft. long and 325 ft. wide.

The most serious railway accident of the week was a derailment June 28 on the Illinois Central R. R., at Eighty-first St., Chicago, Ill. The engine of a southbound train of the Cleveland, Cincinnati, Chicago & St. Louis Ry. jumped the track at a spot where repair work had been in process, and went into the ditch, followed by the baggage car. Four persons were injured, but none seriously.

A leak in the wall of the water-works reservoir at East Liverpool, O., occurred June 30, and the water has had to be let out.

The floor of the light temporary structure for the color department at the World's Columbian Exposition gave way under a crowd June 29. It was never intended for such a load, but a crowd of employees had assembled to make a presentation to Mr. Millett, the chief of the department. About 18 persons were injured, but none very seriously.

An exhibit illustrating the water-works of New York city, under the direction of Mr. Edward Wegmann, Jr., was on view July 1 at the photographic studio of Mr. J. F. Main. The exhibit will be sent to the World's Columbian Exposition. It includes about 125 photographs of different parts of the works and of the Croton watershed, and in addition a large number of drawings showing the construction of the dams and other accessories. All the views and drawings are mounted on cardboard of uniform size, of which there are 100 sheets.

The water and electric light plants owned by the Tacoma Light & Water Co. have been bought by the city for $1,750,000. Auburn, Me., and Auburn, N. Y., Haverhill and Quincy, Mass., Atlantic City, N. J., and many other municipalities throughout the United States, have recently either bought or contracted to buy the private plants furnishing their water supply, while Perth Amboy, N. J., Athens, Ga., Austin, Tex., and several other towns supplied by private companies have built or are now building independent systems. Long legal fights have preceded or accompanied some of these transactions, that at Athens, Ga., not being settled yet.

Provision for continuing the topographical survey of the State of New York was made at the last session of the legislature by appropriating $30,000 to defray expenses. Of this sum, $24,000 has been expended under the joint jurisdiction of the State Engineer and Surveyor and the Director of the United States Geological Survey, it being stipulated that the United States shall contribute an equal amount toward carrying out the project. The Director of the Geological Survey, Major Powell, has just completed arrangements with the State Engineer, under which work will be carried on during this summer and fall. It is provided that the work shall be based upon the triangulation of the Coast Survey, the Lake Survey, and the New York State Survey, and when the triangulation is deficient it shall be supplemented by the Geological Survey. The scheme contemplates a scale of about 1 in. to the mile, with 20-ft. contour lines, being the same plan adopted in the joint surveys of the New England States and the Geological survey. It is proposed to make 22 sheets this year, each about 15 × 20 ins., and each including 225 square miles of territory. Two of these sheets will be made from surveys near Rouse's Point, three in the eastern portion of the Adirondack region, three in the vicinity of Whitehall, Washington County; two on the Hudson, about Kingston and Catskill; two in the Mohawk Valley, near Fonda and Amsterdam; two about Oneida Lake, in the vicinity of Syracuse; three in the neighborhood of Watertown, Jefferson County; two near Elmira and Ithaca, and three in the neighborhood of Buffalo and Niagara Falls. It is estimated that the entire work will occupy about ten years, and that the result will be a map composed of about 200 sheets and part sheets, each 20 × 15 ins., which give a complete topographical chart of the entire State of New York.

The sewerage and storm-water disposal of Orange, N. J., was commenced in 1891 upon an estimate that the entire cost would be under $500,000. Some additions were made to the original plan, and many local difficulties were encountered, with the result that in addition to an extra $300,000 expended about $175,000 more is needed to complete the system. The entire estimated cost is now $915,000, exclusive of the money paid as a share of the outlet to the Passaic River. The problem now to be solved is the method of raising the required amount as the law limits the bonded indebtedness for sewerage purposes to 10% on the assessed valuation of the city, which is now $7,400,000. Councils are now investigating the situation.

The Long Island Water Supply Co's. case in Brooklyn is opened again by the decision of Judge Pratt, setting aside the award made by the late commissioners of appraisal appointed by the Supreme Court, and appointing a new commission to judge the case. The new commissioners are John L. Hill, Hugo Hirsch, Frederic Jansen, Dr. W. H. Bates and Williamson Rapelje. The latter is the only resident of the Twenty-sixth ward, where the plant of the Long Island Water Supply Company is situated. The original commission, in its majority report, valued the plant and franchise at $570,000; the minority report of two members of the commission fixed the value at $2,000,000, though Mayor Chapin's famous deal put the price at $1,250,000 that the city was then willing to pay. Judge Pratt ignored the engineering facts as set forth before the commission, and set aside the award upon legal points based upon the false assumption that the water supply company was able to supply the requisite amount of water for the entire period of its franchise. An appeal will be taken from Judge Pratt's decision within the next 30 days.

The use of manganese steel for mine car wheels is stated to have shown very favorable results in the matter of durability. As is well known, the wear to which mine car wheels is subjected in the Pennsylvania coal mines is excessive, owing to the practice of "spragging" the wheels and allowing the car to slide down the steep grades. The life of the ordinary chilled wheel under these conditions is very short, but it is stated that with a year's continuous use the manganese steel wheels show no perceptible wear and are apparently in as good condition as ever. Another point in favor of the manganese steel is stated to be their lightness, as they weigh only about two-thirds as much as the ordinary iron wheel. The wheel is manufactured by the Taylor Iron & Steel Co., of High Bridge, N. J.

State convict labor upon country roads is being tried at the Clinton state prison, near Dannemora, N. Y. This is in accordance with the recommendation of Gov. Flower in his last annual message, and an act of the last legislature appropriating $10,000 for the purchase of roadmaking machines and implements for this purpose. The real purpose of this recommendation is to make model roads, under the direction of the State Engineer, to show to county supervisors and to ascertain the cost of various types of roads. A subordinate purpose is to keep the convicts fully employed. Warden Thayer, of the prison does not approve of the system, as he says he has trouble even in the small and isolated village he is at work in from drunken men attempting to bring liquor to the convicts. The present attempt may do as an object lesson, but the general employment of convicts at roadmaking elsewhere in the state would be a failure, he says.

THE "EXPOSITION FLYER" EXPRESS TRAIN TO THE WORLD'S COLUMBIAN EXPOSITION.

One of the most impressive and significant exhibits of the World's Columbian Exposition is not in the Exposition buildings nor formally entered as an exhibit, but it will surely do almost as much as the Exposition itself to impress on visiting foreigners that this is a land of progress. To run 980 miles in 20 hours with a pretty heavy train, and to do it day after day on time with unvarying exactness, is certainly a marvelous and unprecedented achievement. The route is over the New York Central & Hudson River R. R. and the Lake Shore & Michigan Southern R. R. The most experienced traveler finds a trip by this train a new sensation, and although it is hard to set limits to progress it is hard to see how this train can be much improved on until the modern locomotive has given place to some materially better mode of propulsion.

We earnestly advise every person who has only $100 to spare beyond immediate necessities to go to Chicago by the cheapest train he can and spend it there, for in no other way can he get so much for his money. But if he is interested in transportation and has a few dollars more to spare, we as earnestly advise him to go by the "Exposition Flyer," to do which he must secure his place in advance, for the train is now running full both ways nearly every day. Its complement being about 86 passengers, and that being quite enough to make it a highly profitable train, it is not likely, in our judgment, that the train will ever be taken off. Leaving New York at 3 p. m., as it does, or near the end of the business day, and arriving at Chicago at 10 a. m. next day, it practically saves an entire business day to the traveler, as compared with the next fastest (25 hour) trains. As the fare is only $3 more it goes without saying that whoever regards his time as worth more than $3 per day will prefer to take this train, and there is therefore much more reason for the existence of this train than for the 25-hour trains, which merely save a night over the old time of 34 to 36 hours, covering two nights and a day, the fares being respectively $25, $28 and $31* by these trains, including in each case $5 for sleeping car berth.

The perfection of method required for running through trains 980 miles in 20 hours, and the reason why it is remarkable, are but little appreciated even by railway men not directly concerned in handling trains. It is nothing to make an average of 49 miles an hour for any distance, or even 52 or 53 miles per hour with the necessary stops out. Many engines can do that if they have a perfectly clear road; all engines running on a 30-mile average schedule make it for considerable distances in ordinary running. But even with such trains it is a matter of every day experience that they are frequently late, and the very fact that they can make with ease nearly twice their schedule speed is in ordinary railroading the main reliance to keep even 30-mile trains up to schedule, and to save them from getting very late. Few even of railway men, and no general travelers, realize how high the speed often is between stations even of slow trains. A passenger train at 30 miles an hour seems to crawl, at 40 miles to be going about 30, and at 55 to 60 miles to be going about 40.

But a train scheduled to average nearly 55 miles per hour when in motion is incapable of increasing its speed more than to about 70 miles per hour, or, say, 25%, under any conditions for any considerable distance. To have a realizing sense of the magnitude of the achievement in running the "Exposition Flyer," therefore, we must first understand what few men do—how much faster the usual speeds between stations are than they purport to be, and then picture in succession the probable difficulty of keeping up to schedule: (1) With a train on a 20-mile schedule, rigidly restricted to a 25-mile maximum; (2) on a 30-mile schedule, restricted to a 37½-mile maximum: (3) on a 40-mile schedule, restricted to a 50-mile maximum, and so on. It will be obvious to those who know the real conditions that either of these feats would be quite beyond the power of most of our roads as they are at this moment; their men are accustomed to much more leeway in making their schedules. And when we add to this difficulty of system and organization the mechanical difficulty of maintaining engines which make with ease 60 to 70 miles per hour with a heavy train without other breaks than the necessary slow-ups and stops, we have a better idea of what running an "Exposition Flyer" really means.

In the entire distance the train makes only eight stops (including the last one), so that the average run between stations is 123½ miles. The complete schedule has some notable features, and is as follows:

Stations after New York.	Distance between stations. Miles.	Time, including stops. Minutes.	Speed. Miles per hour, including stops.
Albany.....	143	170	50.47
Utica	95	110	51.82
Syracuse. .. .	53	70	45.23
Rochester	80	87	55.17
Erie.	157	199	47.34
Cleveland.....	95	121	47.11
Toledo..... ..	113	137	49.49
Elkhart.....	133	168	47.48
Chicago	111	138	48.25
Totals.	980	1,200	49.00

On the New York Central & Hudson River R. R. it will be seen that, despite the considerable curvature of the Hudson River division, it is the third fastest of them all, being exceeded only by the Syracuse and Rochester division, which is almost free of curves and the Albany and Syracuse division. On the Lake Shore & Michigan Southern Ry., though on better average alinement than the New York Central R. R., the runs are quite a little slower. This is doubtless based on an assumed inferiority of track, though that inferiority is hardly visible to the naked eye or to the other senses. Smoother track there could hardly be under the crucial test of the rear platform of a train running continuously more than a mile a minute. It should be said also that double-tracking work is going on over much of the Air Line division, used for this fast run, and this affects the possible time considerably. The engines used by the Lake Shore are considerably lighter, as below shown, but this is doubtless rather an effect of the slower schedule than a cause. The Lake Shore can use the heavier engines also if it wishes to.

In general it may be said that throughout this run there is no appearance on any part of the line of any difficulty in making time or of fast or reckless running. The present writer shaved without the slightest difficulty or sense of insecurity while the train was making over a mile a minute, as it did for some time before or after. There is more motion and less safety on many lines at 40 miles per hour. The train does not appear to be making (for the good reason that it is not in fact making) especially fast time. It is the continuity and certainty with which the speed is made which makes the train remarkable. As another evidence of this fact the dining car service is but little affected by the speed of the train. Wine bottles and beer bottles stand on the tables without difficulty. The average experienced traveler who should take this train without knowing anything about it, in fact, would find nothing to make him think it was making especially fast time, unless he timed the mile posts, except the fact that he dines just after leaving Albany and breakfasts the next morning just out of Chicago.

To do this feat two large cities are passed by entirely, Buffalo and Toledo. Buffalo is not even stopped at, but is passed by at full speed. A stop is nominally made at Toledo, but without going into the old terminal station. Two other causes also aid toward the speed and smooth motion, the new hydraulic compression buffers which prevent all motion between cars more effectively than any other device now in use, it seems to us, and the new type of steps which fold up against the end of the platform when in motion, and are only lowered at a stop, when they project out beyond the line of the car-bodies in an awkward looking and unfamiliar way, but with the great advantage that when in motion they are folded up flush with the car-body so that they cause no air resistance and also serve as an end guard to the platform, which may then be made the full width of the car and need not be always closed by doors. In very hot weather the doors may be opened and a cooling breeze admitted, which to anyone sitting on the platform is a gale.

Both these devices seem to us so excellent that they are likely to come into more extended use, and we shall illustrate them in an early issue.

To show what this train can and does accomplish in everyday working, and under what difficulties, we took a log of its running for the last 130 miles out of Chicago, over which its schedule time averages about 48 miles per hour. The train was exactly on time both at Elkhart and Chicago, so that the running was normal. Abbreviating the record to bring out its salient features only, it was as follows:

Mile-post.	Miles.	Time, mins.	Speed.	Remarks.
22-17	5	7	43	Slowed up for double-tracking.
17-13	4	4	60	
13-9	4	5:15	46	Double-tracking, yard, crossing.
9-6	3	3:45	48	
6-1	5	4:35	65.4	
1-100	2	10:10	24	5 m. stop at Elkhart.
100-95	5	6:15	48	
95-82	13	16:30	47	
82-78	4	4:35	52	Slowed up for crossing and yard.
78-60	18	19:55	54	
60-58	2	3:40	33	Through La Porte yard.
58-54	4	5:35	43	
54-46	8	8:50	55	
46-35	11	12	55	
35-31	4	4	60	
31-29	2	2:15	53	Slowed up for yard.
29-19	10	9:25	63.6	
19-16	3	3:05	58	Slowed up for yard.
16-0	16	36:20	26	In Chicago, and includes Grand Crossing stop.
Totals.....123		165:10	45	

Throughout this run it was apparent that the engine was being held back for time instead of finding it difficult to make its time. At a number of points which have not been specially noted a slight checking of speed for no other reason could be detected, and yet even on this run, which averaged only 45 miles per hour (owing chiefly to the slower speed on the 16 miles within the city of Chicago), it was necessary to make 60 to 65.4 miles per hour for 23 miles in all in order to make the time. Had the schedule required it, most of the distance could have been made at that speed, as was clear from the motion of the train, and as a matter of fact the 181 miles between Erie and Cleveland has lately been made by the train in 188 minutes, the schedule time being 196. That small gain of eight minutes on the time made daily is so notable that it establishes a new record for regular train speeds.

The total weight of the train is as follows:*

Engine and tender (N. Y. Central R. R.)..	204,000 "
Four through cars.....	320,000 "
Dining car, Albany to Rochester, Toledo to Chicago.....	80,000 "
	640,000 lbs.

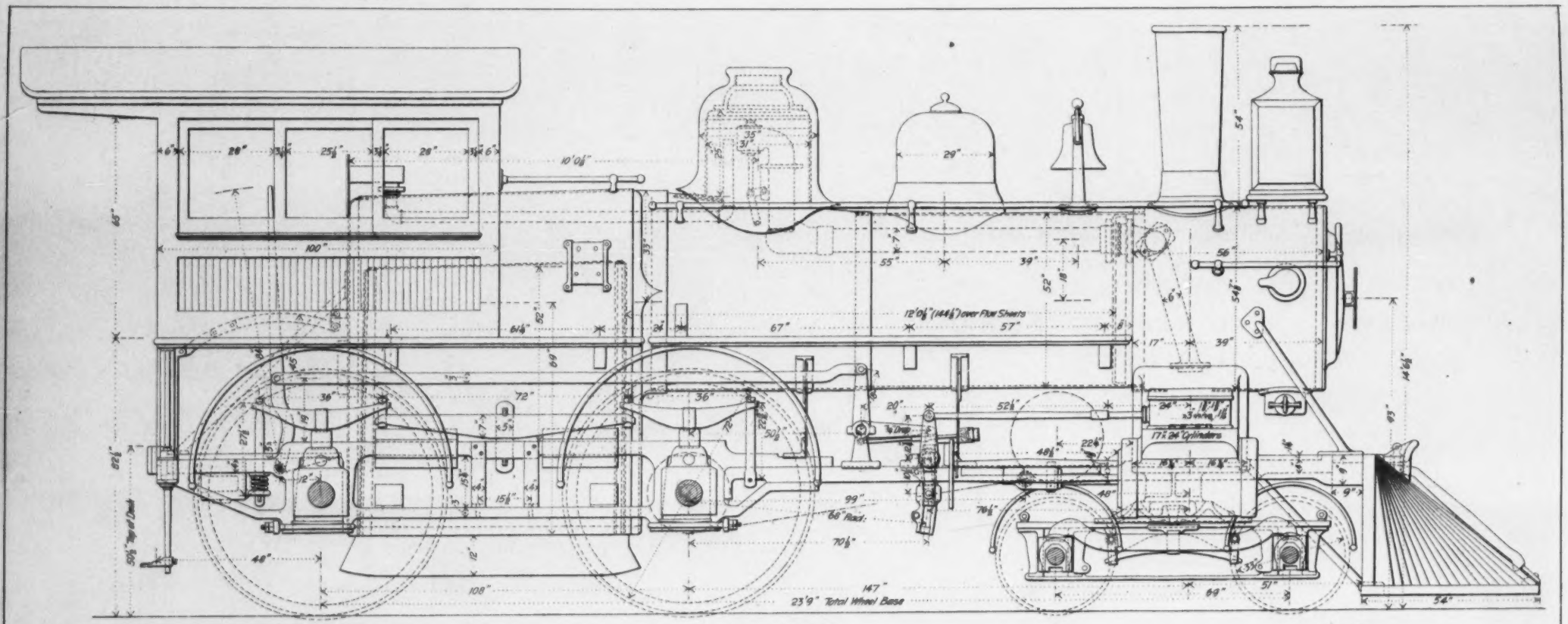
The engines used on the Lake Shore part of the run weigh only 174,000 lbs. One of these engines was illustrated and described in our issue of June 15, and we publish the drawings this week on our inset sheet.

The train weight given alone is equal to 320 net tons, or a fraction less than 270 gross tons of 2,240 lbs., of which about two-thirds, or 180 gross tons, is cars, being 37 tons more than the weight of the Empire State Express (143 gross tons) and within 80 gross tons of the weight of the "Chicago Limited," of the Pennsylvania and New York Central roads, which make the run in 25 hours, that speed requiring an average of only 36.9 miles per hour over the Pennsylvania, however, the distance being only 912 miles.

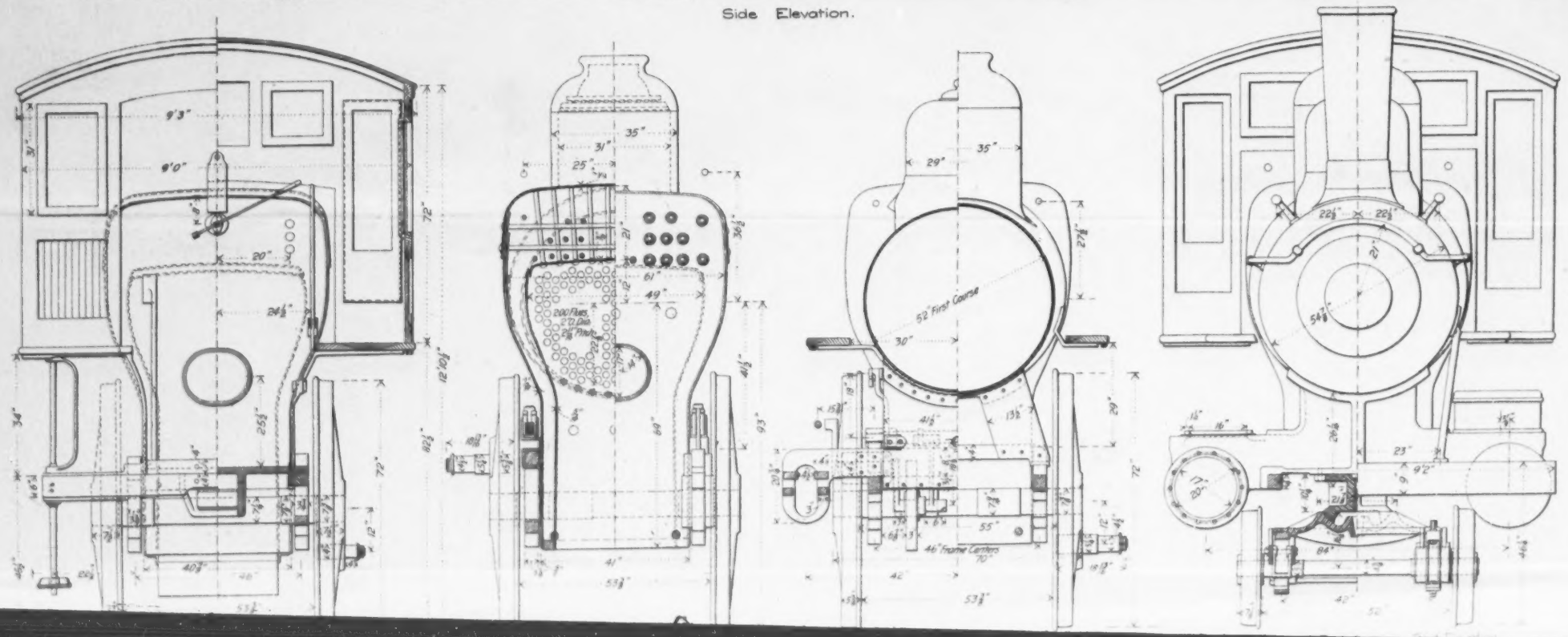
Between 36.9 and 49 miles per hour there is a vast gap, which the Pennsylvania R. R. would much like to close, beyond doubt, but which is, perhaps, beyond its power, owing to the difference in alinement. At mean speeds exceeding 40 miles per hour, the amount and radius of curvature makes a vast difference, having an effect which is not paralleled by its effect at lower speeds. Still, it is only between Harrisburg and Pittsburg that the Pennsylvania R. R. is seriously embarrassed by curvature, and with its decided advantage in distance it ought to be able to arrange a schedule which would meet that of the New York Central

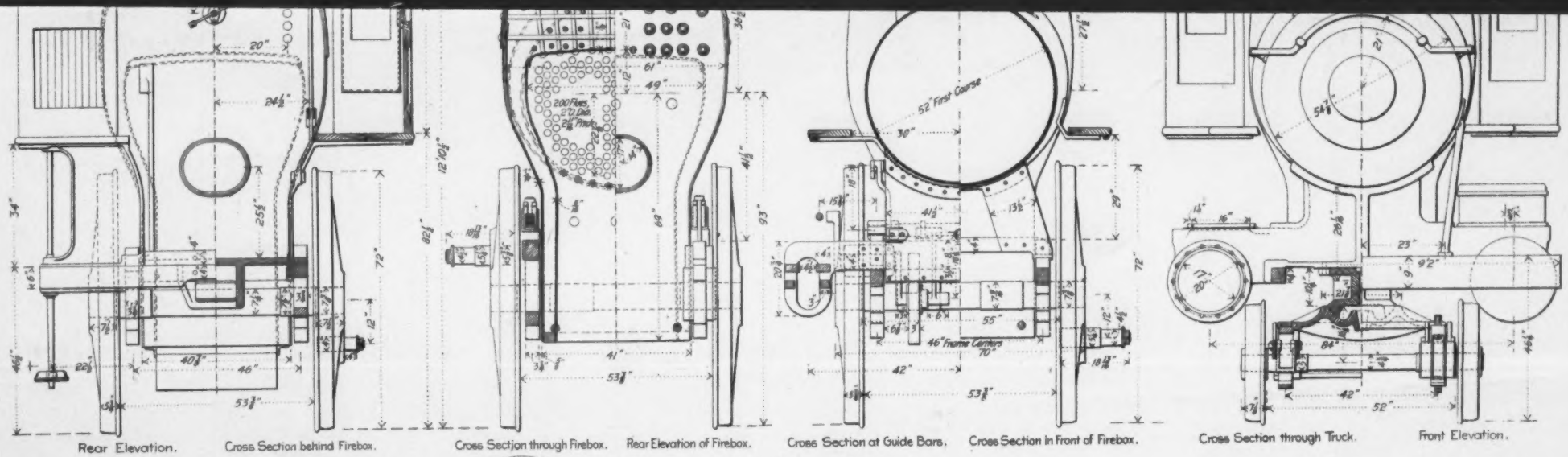
*These are the one way full rates. The round trip tickets, good until the close of the Exposition, which most travelers between New York and Chicago now purchase, cost considerably less, as follows: Over roads having a differential, including all the New York-Chicago routes except the Pennsylvania and Vanderbilt lines, $28; 36-hour trains over Pennsylvania or Vanderbilt lines, $32; 25-hour trains over Pennsylvania or Vanderbilt lines, $40. These prices do not include sleeping car berth, the charge for which is $5 each way over any route.

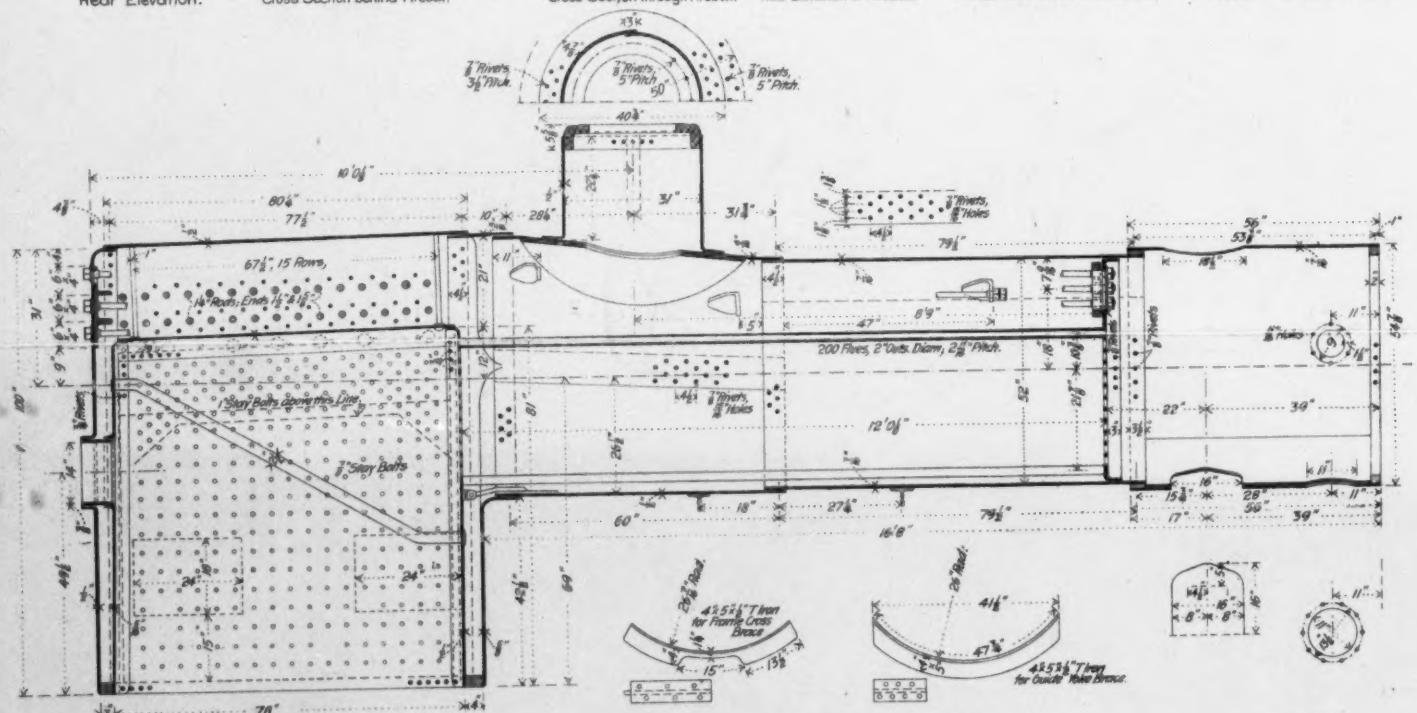
*Another car has been added to the train since the above was written, increasing the total train weight to 720,000 lbs.

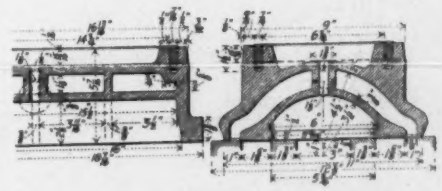


Side Elevation.

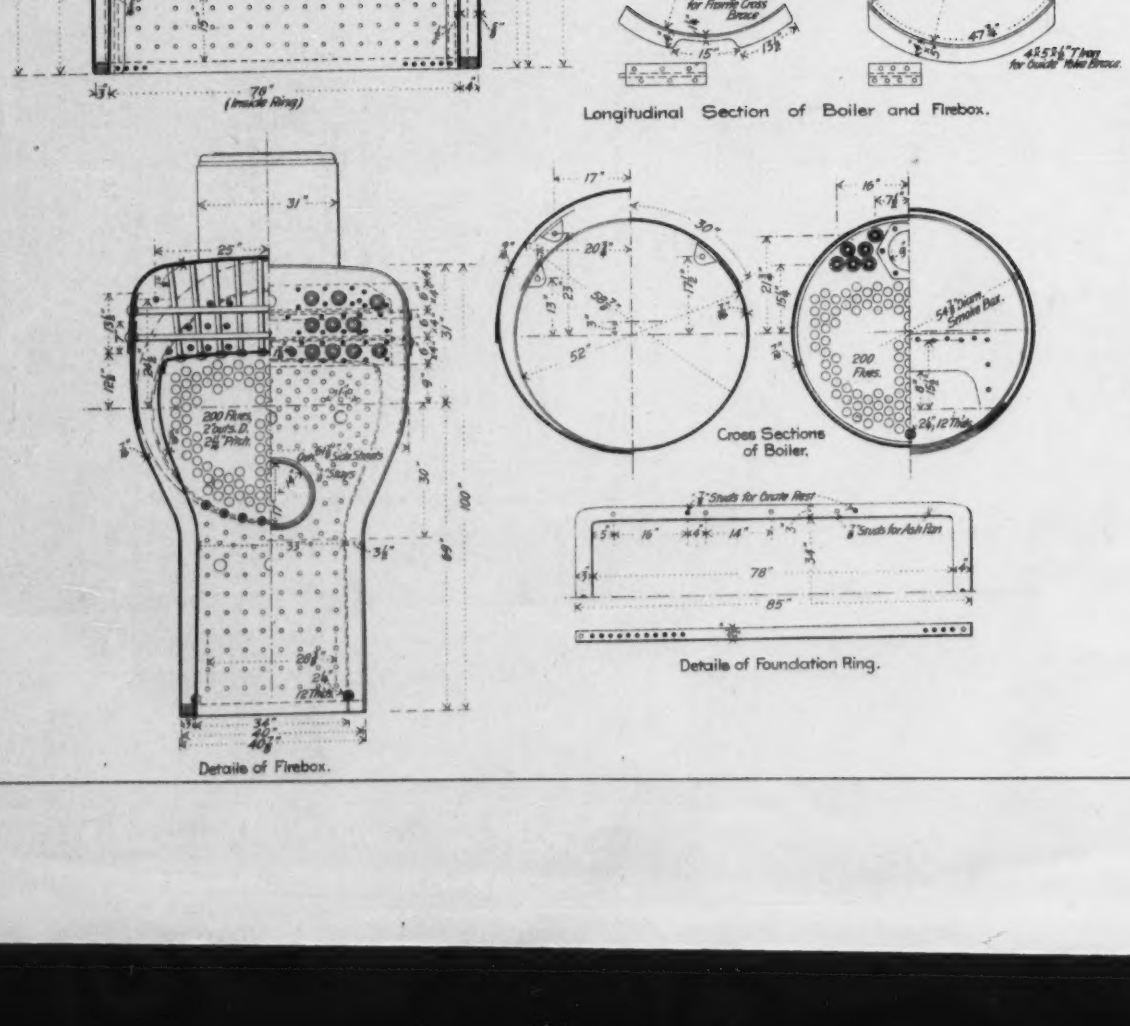





200 Flues, 2" Outs. Diam., 2⅝" Pitch.
12'0" o/s
10'0" o/s
Stay Bolts Above this Line
1" Stay Bolts
4½ x 5⅛" T Iron for Frame Cross Brace
4½ x 5⅛" T Iron for Guide Yoke Brace



Details of Slide Valve.



Longitudinal Section of Boiler and Firebox.

Details of Firebox.

Cross Sections of Boiler.

Details of Foundation Ring.

EIGHT-WHEEL LOCOMOTIVE
FOR THE "EXPOSITION FLYER" EXPRESS TRAIN;
LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

George W. Stevens, Superintendent of Motive Power.
Brooks Locomotive Works, Builders.

CHAS. HART & SONS, LITH., 20 VESEY ST., N. Y.

R. R., one would think, by avoiding the considerable loss of time in running into and out of the Philadelphia terminus.

There is a prevalent impression that these high-speed trains cannot pay, but that idea is largely a mere survival, based on impressions transmitted from the iron rail era. In those days high speed was a costly as well as dangerous luxury. At present, our decided impression is that the "Exposition Flyer" is as safe a train as runs on the continent, all things considered, and as to profit, at 70 passengers per train it pays over $2.21 per train-mile gross, in addition to its value as an advertisement, and what can a reasonable manager ask better than that? The train is conspicuously advertised as running "Every day in the year," and we see no reason to doubt that it will do so, and make its time, winter and summer. Neither do we believe that in the long run, after the road is once brought up to the standard required for such service, it costs any more to run such a train than to run the same distance in 36 hours, all things considered. Whether it does or not, however, the train is profitable, if not the most profitable one, and the "Flyer" has plainly come to stay. It is but just to add that every detail of the train service seems worthy of such a train, and hard to improve upon. The time was when the Wagner service was considered rather inferior, and not without reason. It cannot be considered so any longer. On the crack trains at least it seems not only unsurpassed, but hardly capable of improvement, and it is a pleasure to give credit where credit is due.

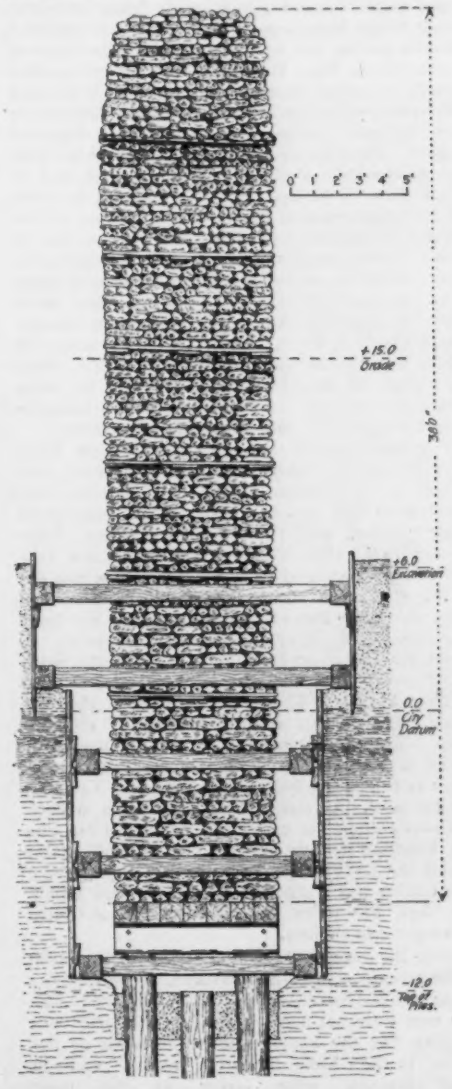
TEST OF BEARING POWER OF PILES.

In connection with the various articles on the bearing power of piles, which we have published during the past year, the following details of a test recently made by Mr. Nicholas E. Weydert, Superintendent of Buildings, of Chicago, Ill., are of considerable interest. Before beginning the masonry for the Chicago Public Library building, which was to rest on pile foundations driven in clay, it was decided to submit a number of piles to a careful test to determine whether the assumed load of 30 tons per pile was safe. This test was made by the contractors for the foundation work under the supervision of Mr. Weydert. A platform 7 ft. × 7 ft., consisting of 12 × 12-in. yellow pine timbers resting on steel I-beams 15 ins. deep, was placed on four piles, and on this platform pig iron was piled to a height of 38 ft. This arrangement is clearly shown in the accompanying illustration. The following is an abstract of Mr. Weydert's report on the test:

The test was commenced in the morning, Jan. 6, a week after the piles to be tested had been driven. The surveyors marked points on top of the piles and took levels on them after the pig iron had been piled to a height of 4 ft., and the load was about 45,200 lbs. This piling up of the pig iron continued irregularly, owing to the severe weather, until Jan. 10, when it had attained a height of 21 ft. and a weight of 224,500 lbs. Levels were taken, but no settlement was discoverable. Jan. 17, at 2 p. m., all the pig iron had been piled on; it had then reached the height of 38 ft., and the load on the four piles was about 404,800 lbs., or about 50.7 tons per pile. Jan. 18, levels were taken and no settlement was discovered. These levels were repeated Jan. 20, after the above load had remained for three days; also Jan. 28, after the load had remained for eleven days, in both cases no settlement being observable. Further tests not being deemed necessary, and the test hindering the progress of the work, orders were given Jan. 29 to proceed with the removal of the pig iron. The four piles, therefore, sustained a load of a little over 50 net tons each for practically a fortnight, without giving any indication of settlement.

The piles were driven by a steam hammer of the Nasmyth type, made by the Vulcan Iron Works; weight, 4,500 lbs.; fall, 42 ins., making 54 blows per minute. The last 20 ft. were driven with a follower of oak. It was found that it required 48 to 64 blows to drive the last foot with the follower, and as the ratio of blows without follower to blows with follower is as one to two, it may be estimated that it would have required from 24 to 32 blows of the above hammer to drive the last foot directly, without follower. In the same soil it required about 16 blows of a drop hammer weighing 3,000 lbs. and falling 30 ft. to drive the last foot, with a follower, as above, and 32 to 56 blows of the same drop hammer falling 15 ft. with a follower.

The piles were driven 2½ ft. between centers, nearly, three in a row along the trench. This is deemed to be as close as they can be driven with ease. They were about 54 ft. long and were driven about 52½ ft. They had an average diameter of 13 in., circumference of 41 in., and an area at tip of 80 sq. in. If a pile similar to the test piles is left for 24 hours, it is found that it requires 300 to 600 blows of the above described hammer to drive it the last foot, or a repetition of 300 to 600 blows of 189,000 inch pounds each. The heads of the piles, after being sawed off, were 27 ft. below the street grade, and the tips about 80 ft. below the same. They were driven about 27 ft. in soft, plastic clay, 23 ft. in tough, compact clay, and 2 ft. in hard pan. The bearing power of this hard pan may be estimated by Rankine's formulas at 170 lbs. per sq. in., and by empirical results at 230 lbs. per sq. in.; in this case it may be a fair assumption that it would carry 200 lbs. per sq. in. The extreme average frictional resistance per sq. in. of sides of piles like



Sketch of Test Load for Foundation Piles; Chicago Public Library.

those described, as deduced from experiments made under analogous conditions, may be placed at 15 lbs. per sq. in.

The average area of the tip of the above piles is 80 sq. in. Therefore, their extreme point resistance will be 16,000 lbs. The average surface of their sides is about 25,000 sq. in., so that their total extreme frictional resistance will amount to 375,000 lbs. As the point resistance in comparison to the latter is but small, it may be neglected, and the ultimate bearing capacity of a pile similar to the test piles may be estimated at 375,000 lbs., or about 180 tons. But inasmuch as the ultimate crushing strength of wet Norway pine may not be over 1,600 lbs. per sq. in., or using a factor of safety of 3, 533 lbs. per sq. in., and whereas the minimum area of piles specified to be not less than 8 ins. at the tip and 16 ins. at the butt, is about 113 sq. in., each pile should not carry more than 60,000 lbs., or 30 tons. This provides a factor of safety of 3 for the crushing resistance of the timber, and a factor of safety of 6 for the frictional resistance of the soil. If the timber be loaded to one-half of its ultimate strength, a load of 90,000 lbs., or 45 net tons, may be assigned to one pile. But in the Library Building, the conservative load of 30 tons per pile was adopted, which gives assurance that this building will not be likely to suffer from any want of strength in its foundations.

LOCOMOTIVE FOR THE "EXPOSITION FLYER"; LAKE SHORE & MICHIGAN SOUTHERN RY.

(With inset.)

A view of one of the five engines used by the Lake Shore & Michigan Southern Ry. to haul the "Exposition Flyer" express train over its road was given in our issue of June 15, together with a full description and list of dimensions. On our inset sheet this week we give the detail drawings of the engine, prepared from blueprints for which we are indebted to the Brooks Locomotive Works, Dunkirk, N. Y., by whom the engines were built. The general design and specifications were prepared by Mr. George W. Stevens, Superintendent of Motive Power, Lake Shore & Michigan Southern Ry., and the engines are of the 17 A class of that road. The leading particulars of the engines are given in the following table, but for a complete description we refer to the article in our issue of June 15:

Driving wheels, diam.	6 ft. 0 ins.
Truck " "	2 " 9 "
Tender " "	3 " 0 "
Wheel base, driving	9 " 0 "
" truck	5 " 9 "
" engine	23 " 9 "
" tender	15 " 0 "
" engine and tender	45 " 8 "
Weight in working order, on drivers	65,100 lbs.
" " on truck	39,500 "
" " engine	104,600 "
" " tender	70,000 "
" " engine and tender	174,600 "
Cylinders	17 × 24 ins.
Boiler, type	Improved wagon top
" diam. of barrel of smokebox	4 ft. 4 ins.
" height from rail to c. line	7 " 9 "
" working pressure	180 lbs.
Firebox, type	Belpaire
" size inside	6 ft. 6 ins. × 2 ft. 10 ins.
Grate area	17.4 sq. ft.
Tubes, charcoal iron, number	200
" diam., outside	2 ins.
" length between tubeplate	12 ft. 0 ins.
Heating surface, tubes	1,258 sq. ft.
" firebox	155 "
" total	1,413 "
Height from rail to top of smokestack	14 ft. 6¼ ins.
Capacity of tank	3,100 gals.
Capacity of coal space	13,400 lbs.
Brake fittings	Westinghouse driver, tender and train

The combination of wagon-top boiler with Belpaire firebox is a new practice, and is for the purpose of increasing heating surface without increasing the weight. The type of slide valve used is shown in detail on the inset sheet. The valves are of the Allen-Richardson pattern, with Allen port ⅝ in. × 16 ins., giving an unusually large port area. This valve, with a lap of 1 in., has an overlap on the outside of the steam port of 1-16 in. The metal is 5-16 in. thick at the wearing face on the outside, and 9-16 in. thick at a distance of ⅞ in. above the face, to prevent the danger of breaking the valve on the outside of the Allen port. The amount of inside lap, 3-32 in. each side, is a characteristic of all the Allen valves used by the Brooks Locomotive Works, and owing to the long travel employed it does not result in excessive compression at the end of the strokes, as might be the case with shorter travel. One object in the use of this amount of inside lap is that it gives the metal of the valve between the exhaust cavity and the Allen port a sufficient bearing upon the port face to prevent the hollowing out of the edges of the ports and edges of the valve, as is the case with Allen valves which have not this additional bearing surface. The general particulars of the valve are as follows:

Steam ports	1⅝ × 16 ins.
Exhaust ports	3 × 16 ins.
Bridges, width	1⅜ in.
Travel of valve in full gear	6½ in.
Lap of valve, inside	3/32 in.
" outside	1 in.
Lead in full gear	3/32 in.
Ratio of area of steam ports to area of piston	1 to 5.73
" exhaust " "	1 to 4.73
Eccentric travel	5 ins.
Dist. c. of axle to c. of rocker	5 ft. 10⅛ ins.
Link, radius	5 ft. 8 ins.
" c. to c. of eyes	1 ft. 1 in.

The weight of train for the first few weeks was 320,000 lbs. (four through Wagner cars), or 400,000 lbs. with dining car on two parts of the run. Recently, however, another through sleeping car has been added, making the weight 400,000 lbs., or 480,000 lbs. with the dining car. It is considered by some authorities that for this particular train, with its high speed and few stops, engines with a single pair of large driving wheels would be specially advantageous. As, however, the highest speeds yet attained, with both light and heavy

trains, and for long and short runs, have been made with engines of the eight-wheel type, it is questionable whether it would be any advantage to introduce a special type of engine. It will be some time before such trains as this become general, and the eight-wheel engine with four-coupled wheels has decided advantages in its capacity for heavier trains, for regular service, and to meet emergencies in bad conditions of weather and track, while the engine with single pair of drivers might perhaps be found unequal to its work with additional cars and a slippery track. This, of course, is looking at the question from the practical point of view of economy in operation, but we should certainly like to see an American express engine with a single pair of large driving wheels put in actual service to see what the result would be in its performance record.

THE UNITED STATES IRON ORE PRODUCTION IN 1892.

In 1892, as in 1891 and 1890, the United States led the world in the production of iron ores and in the manufacture of pig iron therefrom, according to an advance summary of the "Mineral Resources of the United States," prepared by Mr. John Birkinbine, and issued from the government printing office. The output of iron ore for 1892 was 16,296,666 gross tons, against 16,036,043 gross tons in 1890, and 14,591,178 gross tons in 1891, an increase of 260,623 tons over 1890, and of 1,705,488 tons over 1891. Allowing 1½% for small and scattered mines from which no authoritative report is obtainable, the approximate total may be placed at 16½ million tons. In considering these figures it is to be remembered that they represent iron ore ready for the market, in winning which considerable quantities of lean ore, ochre, sand, rock, etc., are brought to the surface and disposed of. In the Lake Superior regions especially large quantities of lean ore are taken out in mining the red hematite. Much of this lean ore is richer in iron than some ores mined and smelted elsewhere, but the long haul to the centers of consumption prevents their profitable smelting.

Table I. gives in a compact shape the production of the several kinds of iron ore in the various iron-producing states and in the United States, and Table II. the comparative production of the different kinds of ore for 1892, and the three preceding years.

Table I.—Showing Gross Tons of the Various Kinds of Iron Ore Mined in 1892 in Each State and in the United States:

	Red hematite, gross tons.	Brown hematite, gross tons.	Magnatite, gross tons.	Carbonate, gross tons.	Totals, 1,000 = ▮
Mich.	7,228,406	187,306	127,832	.....	7,543
Ala.	1,657,028	655,043	.....	.....	2,312
Minn.	1,250,465	5,000	.....	.....	1,255
Pa.	163,307	229,700	685,986	5,054	1,084
N. Y.	124,800	53,694	618,564	64,041	891
Wis.	774,879	5,300	.....	.....	780
Va.	6,120	711,753	3,154	.....	741
N. J.	4,348	4,348	456,759	.....	465
Tenn.	256,786	149,792	.....	.....	406
Ga.	30,855	154,219	.....	.....	185
Colo.	1,412	124,317	16,140	.....	141
Mo.	114,032	4,462	.....	.....	118
Ohio	.....	.....	.....	95,768	95
Ky.	.....	43,254	.....	7,269	50
Mass.	.....	44,941	.....	.....	44
Md.	.....	19,322	.....	20,840	40
Conn.	.....	31,324	.....	.....	31
N. C.	.....	.....	25,379	.....	25
Tex.	.....	22,853	50	.....	22
New Mex.	7,000	.....	8,201	.....	15
Ore.	.....	11,503	.....	.....	11
Utah	2,301	8,800	.....	.....	11
Mont.	4,900	2,170	.....	.....	7
W. Va.	.....	6,090	.....	.....	6
Total.	11,646,619	2,485,101	1,971,965	192,981	16,296
P. c. of total.	71.47	15.25	12.1	1.18	100

Table II.—Comparative Production of Iron Ore, by Kinds in 1889, 1890, 1891 and 1892.

	Amounts produced.				Dec. or inc. % of 1892 over 1891.
	1892. Long tons.	1891. Long tons.	1890. Long tons.	1889. Long tons.	
Kinds of ore.	1=1,000	1=1,000.	1=1,000.	1=1,000.	Per ct.
Red hematite.	11,646	9,327	10,527	9,056	+24.86
Brown hematite.	2,485	2,747	2,559	2,523	— 9.58
Magnetite	1,971	2,317	2,570	2,506	—14.89
Carbonate	192	189	277	432	+ 2.05
Totals.	16,296	14,591	16,036	14,518	+11.69

It will be seen from Table I. that Pennsylvania has fallen from third to fourth position, as to iron ore output, the product of 1,084,047 long tons, being but 6.65% of the total for the United States, showing a decrease of 188,881 tons, or 14.84% from the 1891 output of 1,272,928 long tons. This decline was in all of the varieties or iron ore except the red hematite. Both tables show a growing demand for red hematite iron ores at the expense of the magnetite and brown hematite varieties, but the advance in the amount of red hematite smelted is not so great as would appear from the table, as nearly all of the increased stock of ore at the close of 1892 was of the red hematite class, according to the report.

The cause of the falling off in the brown hematite production was the low price of Lake Superior ores, and the fact that nearly all of this ore has to be washed, thus increasing its cost. The magnetic ores (while sometimes richer in iron) are denser, and furnace operators claim that they require more fuel and care to smelt them, therefore, other things being equal, a blast furnace manager usually prefers the softer hematites. The mines of magnatite in New York and New Jersey are also yearly becoming deeper, and the cost of winning the ores greater, for there labor-saving devices are less liberally employed than in Lake Superior region. These Eastern mines have to bear not only the competition of the Western ores, but also to meet those of foreign countries, and this fact has in late years caused the closing of several of the Eastern magnatite mines; the same is also true of some brown hematite mines near the seaboard. The amount of carbonate ore produced is so small that any local increase has quite a marked effect upon the total; the New York mines show an augmented output, due to the re-opening of some old mines and the increased product of others. Ohio uses some of the local carbonates, but the main reliance of its large iron industry is upon hematite ores brought from the Lake Superior district.

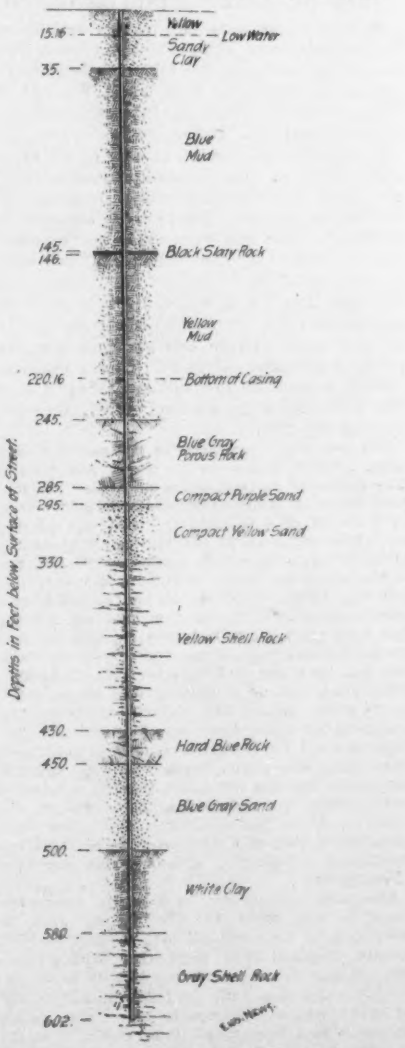
The report states that the states of New York, New Jersey, Michigan, Wisconsin, Minnesota, Alabama, North Carolina, Georgia and possibly Missouri mine iron ores in excess of the demands of their present active smelting capacities, while Pennsylvania, Ohio, Kentucky, West Virginia, Tennessee and Maryland each consume more iron ore in blast furnaces than they produce. The ores from the Lake Superior districts supply the blast furnaces in Michigan, Wisconsin, Minnesota, Illinois, most of those in Ohio, West Virginia, western Pennsylvania, and part of those in the states of New York and Kentucky and eastern Pennsylvania. The foreign iron ores imported (806,585 gross tons in 1892) are chiefly used by blast furnaces in Pennsylvania and Maryland, some ores being at times supplied to New York and New Jersey furnaces. A small amount also comes to Pacific Coast ports. The economies introduced for mining, handling and transporting by rail and water premit the Lake Superior iron ores to meet foreign ores (which pay a duty of 75 cts. per ton) within less than 100 miles of Atlantic ports at equal prices per unit of iron.

While the year 1892 shows an increase over 1890 in the amount of iron ore produced, the total make of pig iron last year was smaller than in 1890. The ores won were not necessarily leaner in 1892 than in 1890, but the amounts of ore stocked at the mines in the Lake Superior region, and in other regions, were larger at the close than at the commencement of the year 1892. This was due partially to the fact that the production of pig iron in the last half of 1891 was much greater than in the first half, and this advance was but slightly checked in the first half of 1892, but in the latter part of last year the pig iron output was materially diminished, thus encouraging large shipments of ore in the first half of the year 1892, while the later decreased demand led to stocking the ore. The iron ore consumers were also discounting the influence which the opening of the new Mesabi range, in Minnesota was expected to exert upon prices for the year 1893. A condition affecting the hard specular mines of Lake Superior was that the ores which were shipped to the furnaces in such condition as to render necessary a reduction of the larger lumps in the stockhouse were met by a decided preference for the softer and more easily handled hematites. The sale of these hard ores was thereby affected, and to overcome this, one large ore mining company put a crusher in operation at the mines, and intends to add others to break the lumps. It is probable that other companies will follow this plan, of making their ore more salable; for in a number of cases the crushing of lumps of banded ore will recover good shipping ore from masses in which lean material preponderates sufficiently to make the whole unmerchantable; and the value of the shipping ore recovered may offset much or all of the cost of crushing the mine output.

As stated before, the amount of foreign ores imported in 1892 was 806,585 gross tons. Its total value was $1,795,644, or $2.23 per ton. About 67% of the imported ore came from the Spanish and Cuban mines, and it is nearly all consumed near the ports of entry. All the iron imported from Cuba comes from the mines operated by American companies, as was that brought from Texada Island, in British Columbia. Until 1892 but one company was mining and shipping ore from Cuba, but last year a second enterprise was represented by actual shipments, and 1893 is expected to add at least one more active corporation to the list of Cuban mines. An American company is also about to exploit an iron ore deposit in Lower California, Mexico, and ship the product into the United States. Over 95% of the ore imported is received at the ports of Baltimore and Philadelphia.

TYPICAL VERTICAL SECTION OF THE NEW ARTESIAN WELLS FOR THE WATER SUPPLY OF SAVANNAH, GA.

The new artesian water supply system of Savannah, Ga., was described in our issue of June 8, 1893. A typical section showing the strata pierced by the wells has since been received and is given herewith. There are twelve 12-in. wells connected with the new supply and 25 connected with old, all



Typical Section of New Artesian Wells; Savannah, Ga.

as described in detail in our issue of June 8. At none of the new wells is the surface of the ground more than 19 ft. above mean low water. We are indebted to Mr. T. T. Johnston, Chicago, Ill., Consulting Engineer, and Mr. W. A. Dayton, Engineer in Charge of Construction, for the section given.

THE DESULPHURIZATION OF IRON.

At the recent meeting of the Iron and Steel Institute, London, two papers on this subject were read, being a continuation of papers published in our issues of Oct. 27 and Nov. 24, 1892, and we take the following abstract of the papers from our correspondent's report of the proceedings of the meeting:

Mr. Stead in his paper dealt chiefly with the Saniter process, upon which he has been engaged for some time past in making experiments. This process is adopted either for purifying fluid pig iron direct from the blast furnace, by running the fluid metal into a ladle having a layer of the purifying material on the bottom, and afterward running the metal into pigs for subsequent use in the puddling furnace, or the crude, sulphury pig is treated in the basic Siemens furnace or Bessemer converter with the mixture introduced by Mr. Saniter. Calcium chloride is the purifying material in admixture with lime; this at present costs $8.40 per ton, and contains 70% absolute chloride. The process has been in use for some time at the Wigan Iron Co.'s works, and a great deal of metal has been treated. The cost of material is only 8 cts. per ton of iron, and other costs have been found to be under 4 cts. per ton. In an instance given, an iron containing 0.64% of manganese, the sulphur was reduced from 0.40% to 0.134%. With a sulphury iron, treated in the basic open-hearth furnace, the elimination of sulphur from pig to steel was 92%. Up to the end of April last, the Wigan Co. had made over 16,000 tons of basic steel from sulphury iron, and had treated over 5,000 tons of iron in the ladle at the blast furnace. Besides this, considerable quantities had been treated at other works in the country. The chief value of the calcium chloride in this desulphurizing process appears to be that it enables a very fluid slag to be formed, but care should be taken that the lime is fairly free from sulphur. There are now two good commercial desulphurizing processes; those of Massenez and of Saniter; and the selection of either of them in the basic process would depend on whether the Bessemer or the open-hearth method were employed; the Massenez being suited for use with the Bessemer plant, while the Saniter process was more adapted for open-hearth working. The importance to the English steelmaker of the Saniter process, together with that of Herr Massenez is great, and may become greater, as we have explained above. Referring to the irregular distribution of sulphur in iron and steel, Mr. Stead stated in his paper that the discordant results obtained by different chemists had been attributed in many cases to the inefficiency of the analyst, while in reality the true cause had been due to difference in the drillings taken from various parts of the piece of iron or steel. It had frequently been found that in certain central parts of the solid steel and iron there was a larger proportion of carbon, sulphur and phosphorus than the average of the whole mass. This fact he illustrated by analyses and sketches of samples planed and drilled. It was, however, fortunate that the less pure portions were concentrated in that part of the mass where they were least likely to have an injurious effect when the iron or steel containing them was subjected to strains.

Mr. Saniter in his paper gave some remarkable illustrations of the excellence of the material treated by his process. The soft steel produced in the open-hearth furnace from the purified iron proved equal, both in chemical composition and mechanical quality, to the best Swedish bar iron. This steel has been tested in Sheffield for various purposes for which Swedish bar is used—in making the highest class of cutlery and tool steels, and with marked success. It had also been found nearly equal to the best charcoal iron, and it welds exceedingly well.

Appended to Mr. Saniter's paper was a report by Mr. G. J. Snelus, describing extended tests of the process and its product. The following is quoted from this report:

> I had some open-hearth ingots heated on the second day and rolled into 2-in. billets. These were afterward rolled into ⅝-in. round bars, and tested for tensile strength in my presence. The ingots were 12 ins. square, weighing 16 cwt. They were heated (from cold) in 1 hr. 20 mins., and rolled off in twelve passes in the roughing rolls to nine passes in the finishing rolls. I was remarkably struck by the fine quality of the steel. I could not detect the slightest flaw or sign of red-shortness in any of the ingots or in the finished billets, although I examined them minutely. In fact, I never saw any steel roll cleaner or better than this did, and the practical tests fully corroborate the analytical results which follow, and show clearly that this process is most effectual in desulphurizing the commonest kind of pig iron to such an extent that the highest class of steel can be made from it. The materials employed are not costly, and there is no difficulty in carrying out the process and in producing uniformly good results.
>
> The analyses showed, and all my observations confirm, the conclusion, that this is a thoroughly practical, reliable, and inexpensive process for desulphurization; and that by it, using the basic process, white iron made entirely from cinder can be converted into excellent steel without undue waste or loss of time.

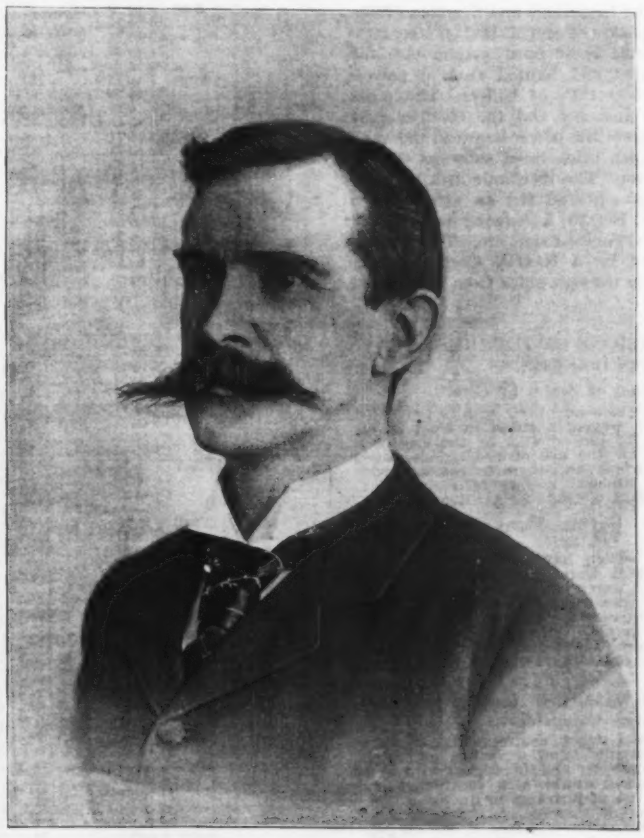
HENRY M. HOWE.

Mr. Henry M. Howe, who was elected President of the American Institute of Mining Engineers, at the meeting at Montreal in February (Eng. News, March 2, 1893), is the son of the eminent Dr. Samuel G. Howe, whose philanthropy was crowned by more than one European state with rare decorations and inspired Whittier's noble poem "The Hero," and of Mrs. Julia Ward Howe, author of the well known patriotic "Battle Hymn of the Republic." Born in Boston in 1848, Mr. Howe graduated in 1869 from Harvard College, and in 1871 from the Massachusetts Institute of Technology, where he led his class. He then entered into practical work, working for eight months in the Troy Steel & Iron Works, Troy, N. Y., so that he not only understood but actually executed the more important and difficult operations connected with steel making. His experience and achievements here brought him an appointment as manager of the Bessemer steel works then being built at Joliet, Ill. In 1874 he was married to Miss Fannie Gay, of Troy, N. Y. He continued in charge of metallurgical works until 1883. In 1877 he went to Chile on an important commission connected with copper smelting, and in 1880 to 1882 he designed and built the works of the Orford Nickel & Copper Co., at Capelton, Can., and at Bergen Point, N. J. Since 1883 he has resided in Boston, and has been busily engaged as a consulting metallurgist and as an expert in metallurgical patent causes.

He has written over 100 papers and articles, chiefly on metallurgical subjects, and most of his writings have appeared in the Transactions of the American Institute of Mining Engineers, or in the "Engineering and Mining Journal." His most important works have been one on "Copper Smelting," which appeared as Bulletin 26, of the United States Geological Survey, and his treatise "The Metallurgy of Steel," which appeared in 1890, and is now in its third edition. For this latter work he received a prize of $500 from the Societe d'Encouragement, of Paris. This work has been translated into French. He was a juror in the class of "Mining and Metallurgical Processes" at the Paris Exhibition of 1889. Mr. Howe has traveled extensively, having visited Europe four times, twice for about a year at a time, and having traveled in South America, been up the Nile, visited Greece, Turkey, the Hudson Bay Territory and nearly all parts of this country and Canada. For many years he has been a non-resident lecturer on metallurgy at the Massachusetts Institute of Technology.

He has made many scientific researches, mostly at very high temperatures; including investigations into the melting points of silicates, the specific heat of several substances at high temperatures, and the effects of very high temperatures on the properties of metals, on which latter subject he is now at work.

Mr. Howe has several times been an officer of the American Institute of Mining Engineers, is an honorary member of other scientific societies, and is now serving his third term as President of the Alumni Association of the Massachusetts Institute of Technology.



Henry Marion Howe.

RAILWAYS IN CAPE COLONY.

Some particulars of the extension of the Cape Government Railways were given by a correspondent in our issue of June 1, and we have since received some further particulars from Mr. A. Diford, Assistant General Manager, in regard to the northern extension. Within the last few years the Western system (from Capetown) has been extended northward 127 miles to Vryburg, and a further extension to Mafeking has just been commenced by the British South Africa Co. As an extension of the Midland system (from Port Elizabeth) the Colesburg Orange River line has been carried out to the borders of the Orange Free State, and this line in turn was extended about 333 miles from the Free State to the Vaal River, and there joins the railways of the Netherlands South Africa Co. to Johannesburg and Pretoria, in the South African Republic. A line has also been constructed from a point on the Eastern system, 247 miles from East London, to Springfontein, where it joins the trunk line through the Free State.

NOTES FROM THE ENGINEERING SCHOOLS.

The University of Kansas, at Lawrence, Kan., is about to make two considerable additions to its buildings. Van Brunt & Howe, architects, of Kansas City, have completed plans for a $70,000 library building and a $10,000 residence for the president. The contract for these two buildings will be awarded about the middle of July. Mr. Davis, State Architect, is at work on the plans of a $50,000 physics and electrical engineering building, which will also be built at once.

The University of the State of Missouri has had its equipment increased by half a dozen new buildings, including a chemical laboratory, law school, museum, physics and engineering building and mechanic arts buildings. Each of these buildings has two stories and basement and is built of pressed brick with cut stone trimmings and limestone foundations. All ceilings are of cement laid on steel lathing, and all flooring is of hard maple. All the buildings are heated and lighted from a power-house containing 400 HP. of boilers. The pipes for steam, water and gas and the electric light wires are carried from the power-house to the various buildings through brick lined subways 6½ ft. high and 4 ft. broad. The mechanic arts building has six shop rooms, 40 × 40 ft.; an exhibit hall, 25 × 40; two offices, 16 × 18; a drawing department, 40 × 40; storerooms, engine-room, etc. The driving power is furnished by a 60-HP. Corliss engine which gets its steam through pipes from the power-house.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Obstruction of Street by City.

A city is not liable to a lot owner who is prevented from using, with his wagon, a street in front of his premises, by reason of the erection by the city of a platform and steps for the use of pedestrians, since such injury is one which he suffers in common with the general public. (Hobson v. City of Philadelphia. Supr. Ct. of Penn., Feb. 6, 1893. 25 At. Rep., 1046.)

Water Companies Laying Pipes in Adjoining Villages.

Water companies which have obtained permission to supply a village with water have the right, under law 1890, to lay their water pipes in any street of an adjoining village to the village where such permit has been obtained, whether the authorities of such village consent thereto or not. (Village of Pelham Manor v. New Rochelle Water Co. Supr. Ct., Gen. Term, Second Department. Feb. 13, 1893. 21 N. Y. Sup., 1110.)

Contracts Between Municipal Corporations and Water Companies.

Where a city entered into a contract with a water company for the construction of a system of waterworks, and supplying the city and its citizens with wellsettled and wholesome water, and contracted for certain rates for the use of hydrants in the extinguishment of fire, flushing of gutters, etc., the company agreed to furnish water to the city free at certain public places, and to furnish it to the citizens of the city at certain rates. That it is not only the right of the city authorities, under the contract between said parties, but it is their duty, to enforce the terms of the contract as to the quality of the water supplied, not only to the city for public purposes, but also to private citizens for private purposes. (City of Winfield v. Winfield Water Co. Supr. Ct. of Kan., 32 Pac. Rep., 663.)

THE WORKS OF THE EAST JERSEY WATER CO. FOR THE SUPPLY OF NEWARK, N. J.*

(Continued from p. 560.)

The Weekly Flow of the Pequannock River for Two Years.—The following table illustrates the action of the three principal parts, and of the whole, of the drainage area and of the reservoirs in suppying 50,000,000 gallons daily. It is based on careful daily measurements of the natural flow of the river, being the flow of the river as it would have been at the intake dam had there been no works constructed by the East Jersey Water Co., and on an assumed draft of 50,000,000 gallons daily during the same time. It is the intention to continue these daily gagings and records, as part of the duties of operating the works. If continued long enough these tables will evidently present just as good a measure of the capabilities of the drainage area in question as any tables of rainfall, with their annually and monthly varying appurtenant coefficients of yield, can possibly present.

*Abstract of a paper on "The Works of the East Jersey Water Co. for the Supply of Newark, N. J.," read before the New England Water-Works Association at Worcester, Mass., June 15, 1893, by Clemens Herschel, M. Am. Soc. C. E., Engineer and Superintendent. The paper, with illustrations and discussions, will be published in the Journal of the New England Water-Works Association for September, 1892.

Flow of the Pequannock River, by Weeks; and Volume in Store in Each Reservoir, if 50,000,000 Gallons per Day Had Been Drawn through the Conduit from June 1, 1891, to May 28, 1893.

All quantities in million gallons.

	Flow of river per drainage area.			Total natural flow of river.	Taken from or added to Oak Ridge.	Volume in Oak Ridge.	Taken from or added to Clinton.	Volume in Clinton.	Waste from each drainage area.			
	Macopin.	Oak Ridge.	Clinton.						Macopin.	Oak Ridge.	Clinton.	Total waste.
1891.												
June 1 to 7	91	94	33	218	−132	2,426	....	3,539	..	..	..	..
8 to 14	73	75	28	174	−176	2,250	....	3,539	..	..	..	..
15 to 21	39	40	14	93	−257	1,993	....	3,539	..	..	..	..
22 to 28	44	45	15	104	−246	1,747	....	3,539	..	..	..	..
29 to July 5	31	30	11	72	−278	1,469	....	3,539	..	..	..	..
July 6 to 12	25	25	9	59	−291	1,178	....	3,539	..	..	..	..
13 to 19	21	21	7	49	−301	877	....	3,539	..	..	..	..
20 to 26	31	31	11	73	−277	600	....	3,539	..	..	..	..
27 to Aug. 2	38	39	14	91	−259	341	....	3,539	..	..	..	..
Aug. 3 to 9	32	33	11	76	−274	67	....	3,539	..	..	..	..
10 to 16	30	30	11	71	....	67	−279	3,260	..	..	..	..
17 to 23	68	70	24	162	....	67	−188	3,072	..	..	..	..
24 to 30	481	492	172	1,145	+492	559	+172	3,244	131	..	..	131
31 to Sept. 6	170	173	60	403	+173	732	−120	3,124	..	..	..	..
Sept. 7 to 13	135	139	48	322	....	732	− 28	3,096	..	..	..	..
14 to 20	61	62	22	145	....	732	−205	2,891	..	..	..	..
21 to 27	48	49	17	114	....	732	−236	2,655	..	..	..	..
28 to Oct. 4	42	42	15	99	....	732	−251	2,404	..	..	..	..
Oct. 5 to 11	43	44	16	103	....	732	−247	2,157	..	..	..	..
12 to 18	31	31	11	73	....	732	−277	1,880	..	..	..	..
19 to 25	40	40	14	94	....	732	−256	1,624	..	..	..	..
26 to Nov. 1	28	28	10	66	....	732	−284	1,340	..	..	..	..
Nov. 2 to 8	31	31	11	73	....	732	−277	1,063	..	..	..	..
9 to 15	72	73	26	171	....	732	−179	884	..	..	..	..
16 to 22	325	332	116	773	+307	1,039	+116	1,000	..	..	..	..
23 to 29	288	365	118	771	+303	1,342	+118	1,118	..	..	..	..
30 to Dec. 6	358	307	143	806	+307	1,649	+143	1,261	6	..	..	6
Dec. 7 to 13	279	259	169	707	+188	1,837	+169	1,430	..	..	..	..
14 to 20	153	123	293	572	..	1,837	+122	1,552	..	..	..	..
21 to 27	382	437	222	1,041	+437	2,274	+222	1,774	32	..	..	32
28 to Jan. 3	873	755	238	1,866	+284	2,558	+238	2,012	523	471	..	994
1892.												
Jan. 4 to 10	469	439	263	1,171	....	2,558	+263	2,275	119	439	..	558
11 to 17	868	868	287	2,023	....	2,558	+287	2,562	518	868	..	1,386
18 to 24	782	783	248	1,813	....	2,558	+248	2,810	432	783	..	1,215
25 to 31	333	333	111	777	....	2,558	+111	2,921	..	316	..	316
Feb. 1 to 7	226	226	65	517	....	2,558	+ 65	2,986	..	102	..	102
8 to 14	199	200	48	447	....	2,558	+ 48	3,034	..	49	..	49
15 to 21	138	139	47	324	− 73	2,485	+ 47	3,081	..	..	..	..
22 to 28	202	203	56	461	+ 55	2,540	+ 56	3,137	..	..	..	..
29 to March 6	156	156	87	399	− 38	2,502	+ 87	3,224	..	..	..	..
Mar. 7 to 13	361	361	102	824	+ 56	2,558	+102	3,326	11	305	..	316
14 to 20	232	233	98	563	....	2,558	+ 98	3,124	..	115	..	115
21 to 27	288	288	104	680	....	2,558	+104	3,528	..	226	..	226
28 to April 3	340	341	100	781	....	2,558	+ 11	3,539	..	331	89	420
April 4 to 10	246	247	83	576	....	2,558	....	3,539	..	143	83	226
11 to 17	160	160	80	400	....	2,558	....	3,539	..	..	50	50
18 to 24	182	182	80	444	....	2,558	....	3,539	..	14	80	94
25 to May 1	58	58	80	196	−154	2,404	....	3,539	..	..	..	..
May 2 to 8	115	115	80	310	− 40	2,364	....	3,539	..	..	..	..
9 to 15	125	126	80	331	− 19	2,345	....	3,539	..	..	..	..
16 to 22	323	196	83	608	+115	2,520	....	3,539	..	..	83	83
23 to 29	377	364	114	855	+ 38	2,558	....	3,539	27	326	114	467
30 to June 5	523	258	156	937	....	2,558	....	3,539	173	258	158	587
June 6 to 12	354	508	131	993	....	2,558	....	3,539	4	508	131	643
13 to 19	145	155	53	353	....	2,558	....	3,539	..	3	..	3
20 to 26	165	182	65	412	..	2,558	....	3,539	..	62	..	62
27 to July 3	139	151	50	340	....	2,558	− 10	3,529	..	..	..	..
July 4 to 10	73	79	26	178	....	2,558	−172	3,357	..	..	..	..
11 to 17	44	47	17	108	....	2,558	−242	3,115	..	..	..	..
18 to 24	28	30	10	68	....	2,558	−282	2,833	..	..	..	..
25 to 31	34	38	14	86	....	2,558	−284	2,569	..	..	..	..
Aug. 1 to 7	45	48	16	109	....	2,558	−241	2,328	..	..	..	..
8 to 14	72	77	26	175	....	2,558	−175	2,153	..	..	..	..
15 to 21	21	23	9	56	....	2,558	−294	1,859	..	..	..	..
22 to 28	72	82	26	180	....	2,558	−170	1,689	..	..	..	..
29 to Sept. 4	106	35	23	164	....	2,558	−186	1,503	..	..	..	..
Sept. 5 to 11	36	26	10	72	....	2,558	−278	1,225	..	..	..	..
12 to 18	98	105	37	240	....	2,558	−110	1,115	..	..	..	..
19 to 25	37	42	15	94	....	2,558	−256	859	..	..	..	..
26 to Oct. 2	12	14	12	38	....	2,558	−312	547	..	..	..	..
Oct. 3 to 9	17	21	8	46	....	2,558	−304	243	..	..	..	..
10 to 16	14	16	5	35	− 9)	2,468	−225	18	..	..	..	..
17 to 23	16	19	2	37	−313	2,155	....	18	..	..	..	..
24 to 30	16	18	2	36	−314	1,841	....	18	..	..	..	..
31 to Nov. 6	80	23	3	106	−247	1,594	+ 3	21	..	..	..	..
Nov. 7 to 13	80	81	16	177	−189	1,405	+ 16	37	..	..	..	..
14 to 20	419	434	154	1,007	+434	1,839	+154	191	69	..	..	69
21 to 27	133	135	78	346	− 82	1,757	+ 78	269	..	..	..	..
28 to Dec. 4	98	105	51	254	−147	1,610	+ 51	320	..	..	..	..
Dec. 5 to 11	218	306	108	632	+174	1,784	+108	428	..	..	..	..
12 to 18	185	207	86	478	+ 42	1,826	+ 86	514	..	..	..	..
19 to 25	93	98	49	240	−159	1,667	+ 49	563	..	..	..	..
26 to Jan. 1	122	131	51	304	− 97	1,570	+ 51	614	.	..	..	..
1893.												
Jan. 2 to 8	381	413	160	954	+413	1,983	+160	774	31	..	..	31
9 to 15	168	182	75	425	0	1,983	+ 75	849	..	..	..	..
16 to 22	88	94	45	227	−168	1,815	+ 45	894	..	..	..	..
23 to 29	120	130	56	296	−100	1,715	+ 36	930	..	..	..	..
30 to Feb. 5	170	184	58	412	+ 4	1,719	+ 58	988	..	..	..	..
Feb. 6 to 12	559	599	160	1,319	+599	2,318	+100	1,144	210	..	..	210
13 to 19	508	546	203	1,257	+240	2,558	+303	1,351	158	376	..	464
20 to 26	473	508	115	1,096	0	2,558	+115	1,466	123	508	..	631
27 to March 5	232	251	75	558	0	2,558	+ 75	1,541	..	133	..	133
Mar. 6 to 12	727	788	204	1,719	0	2,558	+204	1,745	377	788	..	1,165
13 to 19	1,115	1,195	454	2,764	0	2,558	+454	2,199	765	1195	..	1,960
20 to 26	650	705	258	1,613	0	2,558	+258	2,457	300	705	..	1,005
27 to April 2	576	624	288	1,488	0	2,558	+288	2,745	226	624	..	850
April 3 to 9	452	490	248	1,190	0	2,558	+248	2,993	102	490	..	592
10 to 16	391	424	170	985	0	2,558	+170	3,153	41	424	..	465
17 to 23	491	532	225	1,248	0	2,558	+225	3,388	141	532	..	673
24 to 30	362	389	130	881	0	2,558	+130	3,518	12	389	0	401
May 1 to 7	1,118	1,200	409	2,727	0	2,558	+ 21	3,539	768	1200	388	2,356
8 to 14	472	506	173	1,151	0	2,558	0	3,539	122	506	173	801
15 to 21	400	429	146	975	0	2,558	0	3,539	50	429	146	625
22 to 28	191	206	70	467	0	2,558	0	3,539	0	47	70	117
June 1, '91, to May 29, '92 (363 days)*	10,547	10,333	4,206	25,086	.....	.. .	....	....	1,799	4,478	499	6,786
May 30, '92, to May 28, '93 (364 days)*	13,140	13,892	5,011	32,043	.....	.....	....	. ..	3,672	9,107	1,064	13 843

(* The totals here given have been appended to the original table. There are tributary to the Macopin Reservoir 27 square miles; to Oak Ridge 28, and to Clinton 10 square miles of drainage area, making a total of 65 square miles.—Ed.)

THE NORTH AVE. MASONRY ARCH BRIDGE, BALTIMORE, MD.

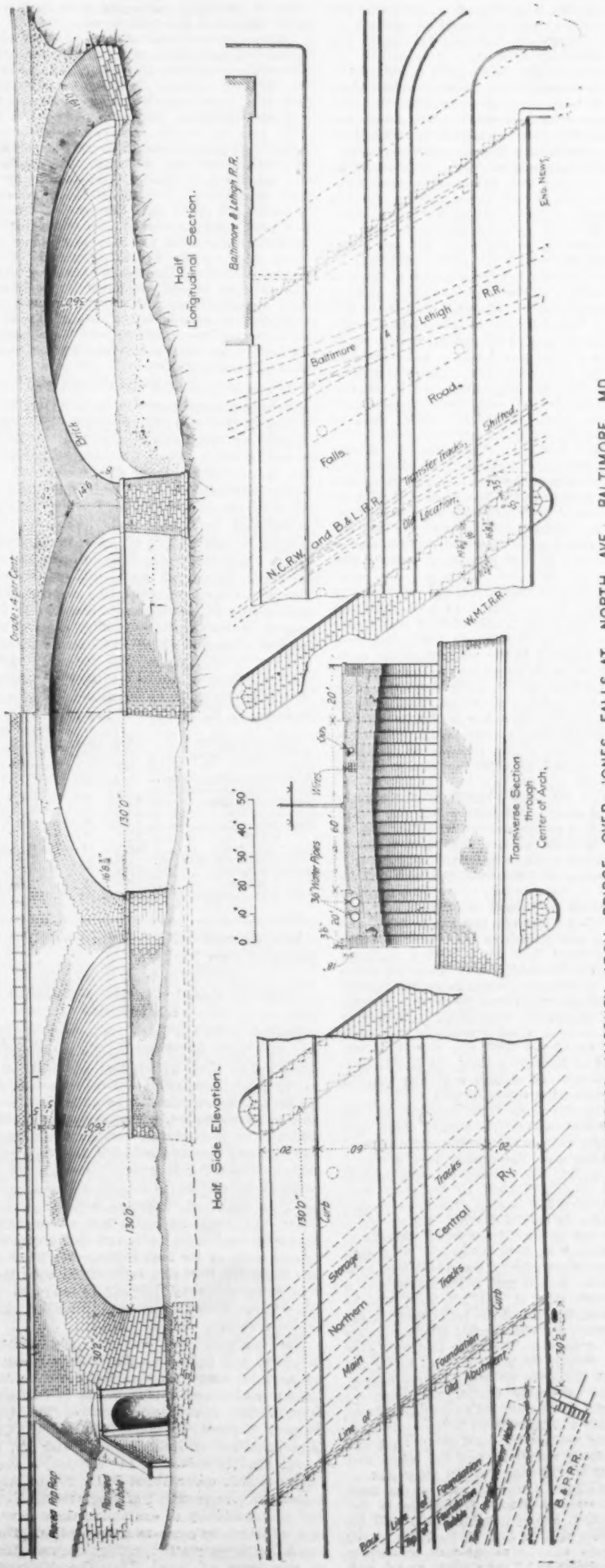
We illustrate in the accompanying cut the general elevation and sections of the large brick and stone arch bridge which is to be built to carry North Ave. over the gorge of Jone's Falls, in the city of Baltimore, Md. Some 20 years ago, when North Ave. was a much less important thoroughfare than it is now, the city constructed a combination wood and cast and wrought iron bridge to carry it over the stream. This structure rapidly deteriorated, until about four years ago it was found that it would need to be practically renewed in order to render it fit for traffic for any great length of time. It was decided, therefore, to replace it by an entirely new structure of modern design, a steel arch being first proposed. Owing, however, to the influence of the various labor organizations (Eng. News, Jan. 30, 1892) masonry was substituted for the steel arch, and bids called for. The lowest of these being found to greatly exceed the appropriation, they were rejected. After a delay of nearly a year new bids were called for and the contract let, as noted in our issue of June 22, to L. B. McCabe & Bro., for $319,915. This contract includes only the bridge proper, and east approach, the west approach not being definitely determined upon in important details.

The bridge was designed by Mr. Frederick H. Smith, M. Am. Soc. C. E., and, as will be seen, consists of three ribbed, skew arches of 130 ft. span and 26 ft. rise supported on masonry piers and abutments. The piers and abutments are on a skew of 35° from the square, or 55° from the axis of the bridge, and the arches consist of 25 ribs 4 ft. wide, each with an offset of 2.8 ft. at the springing line to make up the skew. These ribs terminate on the copings of the piers and abutments at the springing lines. Exclusive of the west approach the bridge is 480 ft. long, 100 ft. wide and from 45 ft. to 60 ft. high, and is on a grade of 4%. All the bedding and jointing of the masonry, the springing lines of the arches on the piers, and the coping are designed to conform to this grade. The gorge which the bridge spans contains the main and yard tracks of two railways, the right of way for a third railway, a main street of the city, and the stream of Jone's Falls itself.

There are two piers, each 137 ft. long by 16 ft. thick, on the square under the coping and having a batter of 1 in 12 on all sides and semi-circular ends. They are about 24 ft. high, including two base courses, and are to be built down into the bedrock which shows irregular upturned edges of schistose beds more or less softened by decomposition and containing mud seams. This bedrock is to be cut into and scraped out and treated with fine concrete or otherwise, until a foundation satisfactory to the engineer is obtained. The following is a condensed abstract of the specifications for the masonry:

Piers.—The copings will be beveled and show rock face, and be 18 ins. thick. The stones will be clamped together with 1-in. square galvanized iron, and their upper surfaces will be cut or hammered to a series of steps corresponding to the spring lines of the arch ribs.

The middle, 100 ft. in length, constituting the bodies of these piers below the coping and above the base courses, will be of full range stone masonry in courses of not less than 8 ins. thick, laid on their natural beds and solid in cement mortar. Headers shall be not less than 16 ins. wide nor less than 4 ft. long, and shall hold their sizes back into the wall, and the stretchers shall alternate with the headers and shall be not more than 6 ft. nor less than 3 ft. long, nor less than 16 ins. wide. The headers of any course shall come in between the stretchers of the over and under courses, forming Flemish bond, and this bond will be roughly preserved throughout the backing in the hearts of the piers. The face of the wall will be rock face, and the stones must be square bedded and jointed 16 ins. back from the face. No projection of the rock face shall be over 3 ins., with no hollows. The courses shall be of the least thickness at the top, and their thickness shall increase regularly downward to the base courses, which shall be not less than 12 ins. thick, with 4 ins. projection to each course. The ends of the piers beyond this middle 100 ft. and above the base courses shall be of first-class full ranged rock face stone masonry, laid in cement mortar and in courses of such thickness that each course shall equal two courses of the body of the pier. The Flemish bond is to be used throughout the interior of these pier ends and to interlock with the Flemish bond of the interior of the



THE PROPOSED MASONRY ARCH BRIDGE OVER JONES FALLS AT NORTH AVE., BALTIMORE, MD.

Frederick H. Smith, M. Am. Soc. C. E., Engineer.

pier bodies. There shall be no interstices greater than 1 cu. ft. between the building stones of any part of these piers, and such large interstices may only exist in the hearts of the piers in the builds, and not between the beds, and they shall be solidly filled with fine concrete thoroughly rammed.

The rock bottom under these piers is believed to afford a reliable foundation at the depths shown, and the material to be penetrated in reaching this rock bottom is coarse sand and gravel and boulders with some clay. One of the piers stands in the stream, and will require a cofferdam, while the other may not.

Abutments.—The east and west abutments below the radial spring lines are each formed of a heavy 18-in. course of coping, laid radially and stepped up similarly to the pier copings to receive the arch ribs, and under these copings the wall will show full range rock face stone masonry similar to the piers. All the stones below the spring line will be laid with radial beds, as shown on the drawings, and the exposed surfaces of all the faces will be of the same rock face stone of uniform workmanship and bond that is used in the pier ends or bodies. The interiors will be ranged rubble with radial beds and good bond and no interstices between the stones greater than 1 cu. ft., and these shall be filled with fine rammed cement. The base courses will not rest on the bed rock, which shall be cut into and scraped out and benched and concreted, as may be directed and the spring lines of the arches shall be marked by the projecting radial coping as drawn.

Ring Stones and Spandrels.—The outer rib, or ring stones, and the outer spandrels shall be of the same stone of uniform color as that used in the coping and ends of piers and abutments. The rings will be 5 ft. deep at the crown of the arch, with a keystone 6 ft. deep, and will increase in depth toward the haunches and spring lines of the piers and abutments. The ring stones will be laid in cement mortar. The rings will show rock face and will be in two or more stones, breaking joint as shown, and the outer ends of these ring stones will cut bevel to joint with the spandrel stones. The natural beds of these ring stones will be cut for their full width to the radial lines shown, from the intrados to the extrados of the arch, and they must be so arranged as to have bonding headers extending into the inner ribs from the outer ribs to a distance of 2 ft., as shown by dotted lines on the cross-section of the bridge, one header in each alternate radial course. The mortar joints shall be ⅝ in. or less. The points of the ring stones and keystones must be scabbled off to fit the lagging and all corners must be full.

The spandrels of the outer rib will be of the same stone as the ring stones, and will be full range rock face masonry laid in cement mortar with ⅝-in. joints, with one header to every two stretchers in each course, with beds and joints equal to the depth of the stone. The headers showing in the face of the wall will be not less than 4 ft. long, and there shall be inner or blind headers, which will reach at least 18 ins. into the inner spandrels or into the concrete backing, and all these headers and stretchers must have a width not less than 1¼ times their depth, with a minimum width of 16 ins. The spandrel courses below the crown of the arch square joint up closely against the beveled ring stones and above the keystone the north and south face walls reach to and are surmounted by a beveled rock face coping uniform in color with the ring stone and which shall be 18 ins. thick and 4 ft. wide and project 5 ins. and be hammer dressed and laid in cement mortar. Spandrels and copings will build into the corresponding parts of the approach wall.

Inner Ribs and Spandrels.—The sheeting of the arches will be of brick and in ribs 4 ft. in depth with faces square to the axis of the bridge and offsets of 2.8 ft. at the spring line. These inner ribs will be 5 ft. deep at the crown, and increase in depth toward the spring lines. The brick shall be laid with their beds radial to the arch and in rings, the intrados ring showing only bricks on end, and above this the rings will be of bricks laid on edge, interlocking throughout. The ribs thus formed shall be connected with each other and with the outer ribs by galvanized iron hook clamps of 1 sq. in. section and 2 ft. net length, a clamp to each cubic yard of rib. All brick will be laid with ¼-in. point joints, and the joints between the ribs will be cemented and also grouted after the arches are swung clear of centers. The inner spandrels over the piers will be built of brick up to 14 ft. below the street grade, and the ends of the spandrel courses shall square joint up closely against the inner rib brick courses, which will be beveled accordingly. These inner spandrel walls will be built up in the same bond as the ribs, and the headers will bond across right and left into the adjoining spandrels, and the bricks and workmanship shall be the same for the inner ribs.

Spandrel Filling.—From the west end of the solid ground back of the east abutment the interior of the bridge above the arch and spandrel masonry will be packed with concrete up to a line 4¾ ft. below street grade. The concrete will be second-class, consisting of 1 part natural cement and 7 parts sandy gravel, and laid and rammed in layers to conform to the 4% grade of the bridge. On top of the concrete there will be 4 ft. of gravel, the surface of which shall be smoothed off 9 ins. below the street surface.

Mortars.—The mortar used in all the stone masonry above the spring lines of the arches shall consist of 3 of sand to 1 of Portland cement, and the mortar used in all brick masonry shall consist of 1 of Portland cement to 1 of sand. The Portland cement shall be of an approved brand, uniform in quality, of a fineness of 97%, on a No. 50 sieve, showing initial set in 30 to 60 minutes, a tensile strength of 250 lbs. per sq. in. in 1 day and of 450 lbs. in 7 days. The mortar used in the interior or undressed stone masonry of the piers and abutments shall consist of 1 part natural cement, 2 parts sand and 4 parts fine crushed ¾-in. rock, and the mortar used in the exterior or dressed stone masonry shall consist of 1 part natural cement and 1 part sand. The natural cement shall be of approved brands, uniform in quality, of a fineness of 95%, on a No. 50 sieve, showing an initial set in 30 to 60 minutes, a tensile strength of 150 lbs. per sq. in. in 1 day, and of 250 lbs. per sq. in. in 7 days. In mixing mortar, concrete, etc., the materials must be thoroughly mixed when dry; and then wetted and remixed and used at once in the wall.

It will be seen that the specifications conform to the best modern practice in masonry work. The facing of the arch will be of the well known white marble of the McCabe quarries, at Texas, Md., about 16 miles by rail from the bridge site, except the reveals of the inner ribs, which will show the brick masonry. It may be stated also that the piers of the arches will be further treated before completion to relieve their nakedness.

Since, owing to lack of space for greater dimensions, the piers are too light to resist the thrust of a single completed arch without counteracting thrust of the other arches, the masonry of all three arches must be carried on simultaneously. This, of course, necessitates the construction of the three centers at once. These will contain about 1,350,000 sq. ft. of lumber. The following table gives the quantities of various classes of masonry and the prices for each, as submitted by the successful builders, L. B. McCabe & Bro.:

Kind of masonry.	Quantity.	Price per unit.	Total.
Upper coping stone	180 cu. yds.	$22	$3,930
Pier " "	270 "	25	6,750
Abutment coping stone	40 "	30	1,200
East abutment stone	575 "	12	6,900
Spandrel	1,360 "	12	16,320
Ring	1,425 "	13	18,525
Pier ends	1,100 "	10	11,000
" bodies	3,200 "	10	32,000
Inner rib, brick	15,670 "	9	141,030
" spandrels, brick	520 "	9	4,680
Gravel concrete	5,500 "	3	16,500
" filling	7,000 "	1.50	10,500
Falsework, complete	1,350 M. sq. ft.	37	49,950
Total			$319,915

The contract calls for the completion of the bridge by June 15, 1895.

DINING CARS ON THE MIDLAND RY., ENGLAND.

English railways have been very conservative and backward in improving the passenger accommodation of their trains, and especially in regard to the third-class traffic, but railway managers are beginning to recognize the fact that it pays to provide greater comfort, convenience and luxury than afforded by the ordinary compartment cars. This has long ago been recognized in this country, where such provision for luxurious traveling has been in some cases carried to a rather unreasonable extent. In England, lavatory accommodation, corridor cars, Pullman and other parlor cars have gradually been introduced, and dining cars are now run on some of the long routes. We have at various times recorded and commented upon the progress being made by English railways in making these improvements, and have described and illustrated a number of these cars.

The Midland Ry. has recently built some first-class and third-class dining cars which are to be used in a new express train service between London and Glasgow (444 miles) to commence on July 3. Through the courtesy of Mr. Geo. H. Turner, General Manager; Mr. T. G. Clayton, Superintendent of Rolling Stock; and Mr. P. Osborne, Superintendent of the company's works, at Derby (which cover about 100 acres of land), an occasional correspondent of Engineering News has had an opportunity of examining these new dining cars, of which he sends us a description. The London & Northwestern Ry. dining cars were described in our issue of April 27. The Midland Ry., though the youngest of the great trunk railway systems of Great Britain, has been the pioneer in introducing many arrangements for the safety, comfort and convenience of the traveling public. About 20 years ago, Sir James Allport, then Manager, was the first to conclude a contract with the Pullman Palace Car Co. for the supply of its drawing-room, sleeping and dining cars, which have been in continuous use on this line ever since, and have also been adopted on other roads. The Midland Railway is the first to provide dining car accommodations for third-class passengers, and, as pointed out in an article in our issue of April 13, the third-class traffic is now receiving some of the attention which its importance demands. With the gradual abandonment of the second-class service it is probable that still more attention will be paid to the third-class, which is the remunerative traffic.

The new dining cars are 60 ft. long by 7 ft. 6 ins. wide, with monitor roofs, and are lighted by gas and heated on cold days or evenings in summer, also by gas, but in winter the heating will be by hot water. They are carried on six-wheel trucks and the bodies are stiffened by truss rods. The tables are ranged along the sides between seats placed back to back and having high divisions, and with a window opposite each, with central and side lights. This arrangement is somewhat similar to that of the Pullmans, but the latter have swivel chairs. A central corridor about 2 ft. wide separates the tiers of tables. The tables accommodate two persons each in the first class, and along one side in the third-class cars, but on the other side of the latter each table accommodates four persons. This arrangement is preferred by the Midland Ry. authorities to the side corridor arrangement, which they consider makes that side of the car objectionable for passengers and limits their view. The smoking-room and men's lavatory occupy one end of the car, and the kitchen, pantry and china closet and women's lavatory occupy the other end. The first class kitchen has a convenient cooking range, heated by gas, and the third class has a warming stove. The smoking-room will accommodate nine persons, and the dining-room twelve persons in the first class and 30 in the third class. An electric call for the waiter is fitted to each seat. Parcel racks are provided along the sides, overhead. At each end is a vestibule, with side entrances, and a narrow extension inclosed gangway or vestibule, as used on the English postoffice sorting cars, is attached at the kitchen ends to afford communication between the first and third class cars. Our correspondent states that the Pullman vestibule has not been adopted "because it offers facilities for foul play to evil disposed persons, etc., but this might be avoided by surrounding it with a cage of T-iron frame and wire net paneling." The first class dining cars are finished in varieties of walnut and gold, and upholstered in morocco. The third class are finished in natural light woods with the usual passenger car upholstering. At present the ordinary compartment cars will be used in the new express trains, and therefore access to the dining cars can only be obtained at the few stopping stations, just as the Pullman dining cars are now used by the Midland Ry., which limits their availability.

As the experience in the ordinary compartment cars is that passengers almost invariably prefer corner seats, and avoid the inner ones, it is evident that the American arrangement of a central gangway from end to end would be preferred, at all events for third class passengers, if accompanied with sufficient door accommodation for frequent short stops, and more especially as it would avoid the helpless isolation which has proved so dangerous in the experience of the compartment system, notwithstanding the "cord" or even electrical communication now furnished. Our correspondent suggests, therefore, that a compromise might be adopted in which one-half of the doors, alternating on each side, may be dispensed with, as the central gangway affords a choice of doors; i. e., one door only need be used between each alternate pair of back-to-back seats, and then the end vestibule door may be adopted with the above described protecting cage. In summer these American vestibules are most pleasant viewing stations in which airing can be indulged in without inconvenience to other passengers. This suggested change would only cost the cutting away of the width of the central seat through the partitions of the usual

five seats on each side of a compartment, and thus forming the central gangway of that width from end to end of the carriages, and the permanent closing of one-half of the number of doors on each side. It is doubtful if English railway men will approve of this alteration of the interior of the cars, and it would still leave the objectionable arrangement of seating passengers face to face, which we have commented on in our issue of March 23. Just why a vestibule should need a cage we do not see, as the vestibule is itself an inclosure and its doors can be fastened.

PERSONALS.

Mr. Frank Jones has been elected President of the Boston & Maine R. R. Co., vice Mr. Niven, resigned.

Mr. Ira N. Hollis, Passed Assistant Engineer, U. S. Navy, has tendered his resignation in order to accept the position of Professor of Engineering at Harvard College.

Mr. A. A. Macgregor, Engineer of the Standedge Tunnel, on the London & Northwestern Ry., described and illustrated in our issue of June 29, is now visiting the World's Columbian Exposition.

Mr. Frederick A. C. Perrine, M. Inst. Elec. E., was married on June 28 to Miss Margaret Roebling, daughter of Ferdinand W. Roebling, of Trenton, N. J. Mr. Perrine has recently been appointed to a professorship in Leland Stanford University.

Mr. Harry Footner, Engineer of Permanent Way, London & Northwestern Ry., has been on a visit to this country and returned to England recently. Among other works of importance he laid out the extensive gravity switching yards of this road.

Among the names recently registered on our visitors' list are the following: Harry Footner, L. & N. W. Ry., England; A. A. Macgregor, L. & N. W. Ry., England; Herman Gustafsen, Malmo, Sweden; Prof. A. Riedler, Berlin, Germany; Prof. T. F. von Radlinger, Vienna, Austria, and W. Kummel, C. E., Hamburg, Germany.

Messrs. Yeats & Gibson, civil engineers, Chicago, have dissolved partnership by mutual consent, and the business will be conducted in the future by Mr. R. H. Yeats, with office in the Monadnock Block. Mr. Yeats will continue to represent the Weir Frog Co., of Cincinnati, as its Chicago representative, as well as the interests of the stockholders of the Calumet Electric St. Ry.

Mr. M. J. Caples has been appointed Assistant Engineer of the Clinch Valley and Pocahontas divisions of the Western General Division of the Norfolk & Western R. R., with headquarters at Bluefield, W. Va., vice Mr. A. P. Miller, resigned. Mr. R. G. Kenly has been appointed Assistant Engineer of the Radford Division, with headquarters at Radford, Va., vice Mr. M. J. Caples, transferred.

Mr. Fred C. Williams, of Tonawanda, N. Y., has been appointed Sanitary Engineer of Cleveland, O., by Mr. Farley, Director of the Department of Public Works. His first work will be on the plans for the Walworth Run sewer. Mr. Rice, City Engineer, believes that the work should be pushed as rapidly as possible in order to abate the nuisance of Walworth Run, which is simply an open sewer. Plans for the sewer have been prepared by Mr. Rudolph Hering, the sanitary engineer, and by Mr. Force, ex-City Engineer. Their conclusions do not agree, and Mr. Rice and Mr. Williams will go over the plans.

NEW PUBLICATIONS.

JULY MAGAZINES.—In "Scribner's" the series of articles on men's occupations is continued with a paper by W. Clark Russell, author of "The Wreck of the Grosvenor," on the life of the merchant sailor. Mr. Russell finds it difficult to say anything too harsh concerning the food which is served to the crew of the British sailing ship or tramp steamer. One secret of the extraordinarily low ocean freight rates which now prevail is told in ships undermanned and crews underpaid and half starved. American ships manned by American sailors cannot compete with foreign vessels run on this basis; and we can better afford to let supremacy in the ocean-carrying trade remain across the water than attempt to follow the example of the foreign shipowners. In "Harper's" Poultney Bigelow has a description of German army officers, illustrated by Frederick Remington. In the "Popular Science Monthly" Maj. J. W. Powell discusses the question whether evidences of the existence of man have been discovered in the glacial gravels, and concludes where such evidences have been discovered they hav been wrongly assigned to the glacial period. He also takes occasion to defend the Geological Survey against the charge that it has been unfair in its treatment of Prof. G. F. Wright, author of two recent books on this topic. We have before referred to previous articles in this discussion in the same magazine. The controversy appears to be one in which both sides should be heard before accepting the views of either. In "The Century" we find two replies to the recent paper by the Secretary of the Russian Legation at Washington defending Russian treatment of political prisoners and Jews, and there is an interesting paper by Dr. Allen McLane Hamilton on hypnotism in the treatment of disease.

The "Review of Reviews" contains an article by J. R. Gavath on "Electricity at the World's Fair" and another on "Two Giants of the Electric Age," as Mr. Thos. A. Edison and Sir Wm. Thomson are called. Mr. Chas. D. Lanier writes the sketch of Edison and J. Munroe that of Sir William. Another article of interest is "Our Fifteen New Forest Reservations." All three of the articles are illustrated.

The "North American Review" contains an article on "The Fastest Train in the World," by Mr. H. G. Prout, M. Am. Soc. C. E. In this article Mr. Prout relates his experience on the first round trip of the "Exposition Flyer," and comments on the steps which led up to its installation, and the probabilities of reducing the time between New York and Chicago to 18 hours, which he thinks will yet be accomplished.

SEPARATION OF GRADE CROSSINGS.—Report of a Special Commission on the Separation of Grade Crossings of the Boston & Albany R. R. in the city of Newton, Mass.; Albert F. Noyes, City Engineer of Newton; Chas. A. Allen, Geo. S. Rice, Commissioners. 8vo, paper, pp. 45, 7 plates.

This report contains some interesting matter on the subject of grade-crossing removal. The committee recommends that the railway remain in its present location instead of removing to a new one, as had been proposed, and gives as one excellent reason that the proposed change in location would cause great changes in property values, immensely benefiting some owners of real estate and irreparably injuring others. The elevation of the tracks is recommended in preference to their depression, and embankments with sodded slopes or in places between masonry retaining walls, with masonry or steel arches across the streets, are recommended for the elevated road. The total distance over which it is proposed to change the grades is a little less than five miles, and the commission estimates the cost for a four-track roadway on the present location at $1,965,300, including bridges over 25 streets. This is for embankments with slopes. If the road were built between masonry retaining walls the cost would be $2,251,500. For depressed tracks, with the streets crossing overhead and masonry walls, the estimate is $2,370,600. Copies of the report may be obtained from Mr. A. F. Noyes, City Engineer of Newton.

COMMISSION OF LABOR. Seventh Annual Report. 1891. Cost of Production; The Textiles and Glass. Vol. I., Part 1, Cost of Production: Part II., Wages, Time and Earnings. Washington, D. C.: Government Printing Office. 8vo; cloth; pp. 841.

This report relates to the cost of producing various kinds of textiles and glass in the United States and in Europe, and includes the earnings and cost of living for the persons employed in such production. The official date of the material used is up to Sept. 1, 1891, and the information furnished is issued by Mr. Carroll D. Wright, the then Commissioner of Labor. Some 278 establishments, covering ten distinct industries coming under the common head used, enter into this report, and the Commissioner reports that, whereas it was at first very difficult to obtain from manufacturers the real cost of production, the issue of the previous volume of statistics of 1888 on iron, steel, coal, coke, etc., has shown the common value of such material, and has resulted in overcoming the idea originally prevailing that such reports were inimical to their individual interests. Under the head of cost of production the present report covers the manufacture of the following goods: Cotton textiles and yarns, woolen and worsted textiles and yarns, linen and silk textiles, window glass, green and flint glass bottles and lamp chimneys. These are gone into very fully in each case, in too much detail for even a passing notice. As an example of the summaries given it can be said that the cost of one box of glass is divided into, materials, 10.63%; labor, 38.30%, and all other items, 51.07%, representing a total of $1.0602. One square foot of polished plate glass, for example, costs $0.4865; divided into materials, 10.59%; labor, 40.7%, and all other items, including clerical work, supplies and repairs, fuel, taxes, felt, rouge, sand, etc., 48.71%. The latter half of the volume is devoted to wages, time and earnings—a statement so detailed that no attempt can be made here to even give examples of the summaries. To all interested in these industries the full tables can alone be useful.

PATENTABLE INVENTIONS. By Edward S. Renwick, C. and M. E. and Patent Expert. Rochester, N. Y.: The Lawyers' Co-operative Pub. Co. 8vo; pp. 155; $2.

Mr. Renwick is, and has been for many years, one of the most prominent patent experts in this country, and few men are better qualified by experience to write a book upon this subject. The subject itself, however, is necessarily a limited one, being merely to draw the line at which invention ceases, and new mechanical application begins. While thus limited to a very narrow line, however, yet, as that line bounds for many patents the area which may be covered by claims, it is a constantly recurring problem in the practice of patent attorneys, apart from those relatively rare cases in which the element of invention is so slight that it takes expert judgment to say whether it lies on one side of the line or the other.

The work seems worthy of its subject. It is probably the best which exists on it, and is quite interesting reading apart from its practical value for settling specific issues.

IGIENE DELLE ABITAZIONI. Vol. III. Provvista, Condotta e Distribuzione delle Acque, dell' Ingegnere Donato Spataro. Parte Seconda, La Condotta. Milan, Italy: Ulrico Hoepli. 8vo; 550 pp.; 392 illustrations and 9 tables. Price in Milan: Vol. I., $3.60; Vol. II., $4.00; Vol. III., $3.00.

This is the third volume of an Italian series on sanitary engineering, and is devoted to the design and construction of aqueducts and sewers, and the manufacture, testing and laying of pipe for water distribution. In the latter part, the use of cement and wooden water pipe is also described and discussed. The succeeding chapters deal with the methods of carrying water conduits across streams by submerged pipe, in tunnels, etc.; the construction of gates, valves, check-valves, pressure-regulators, indicators and the multitude of fixtures connected with the distribution of water. The fourth and final chapter deals with the mathematics of the flow of water in pipes and channels. As our Italian editor has not materialized this week, little more is done here than to outline the contents of what seems to be a very carefully worked treatise on the subjects discussed, with illustrations of practice drawn from many sources inside and outside of Italy.

DIE ELECTRISCHEN LEITUNGEN UND IHRE AULAGE FUER ALLE ZWECKE DER PRAXIS (Electric Conduits and their Construction for all Practical Purposes), by J. Zacharias. Second Edition. 12mo.; pp. 245, 89 illustrations. A. Hartleben, Vienna, Pest, Leipzig. Price, 75 cts.

In this handy text book, forming volume XVI. of Hartleben's electro-technical series, the author treats in a clear and concise manner of recent experiments upon the materials used and their selection and adaptability to different purposes, embodying his own experience in this particular line of work. The different systems of laying underground conduits are of especial interest. The construction of overground telegraph, long distance telephone, and electric light conduits are thoroughly described, supplemented by a number of tables for use in conducting periodical tests and measurements of conduits. In the following chapters the laying of underground cables and cables in water are described. Carefully compiled, and concise in style, this little work contains much information on these subjects.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on June 21, a paper by J. A. Ockerson, M. Am. Soc. C. E., on "Erosion of River Banks of the Mississippi and Missouri Rivers," was read by the Secretary. A general survey of the Mississippi River from Cairo, Ill., to Donaldsonville, La., was made by the Mississippi River Commission during the years 1879 and 1883. It comprised a system of secondary triangulations, by which stone monuments were located at frequent intervals along the river to serve as initial points for future surveys. A careful topographic survey was made and additional stone survey marks were set, marking sections of the river at intervals of three miles along its course. On each of these sections usually four stones were placed, one on each side of the river, about a third of a mile from it and another about a half mile further back. A line of precise levels was carried along the river also, and beach marks placed. This survey will be a basis of comparison, therefore, for future surveys.

In the autumn of 1891 about 885 miles of the river's length were re-examined, and a report made to the Commission for 1892. In November, 1892, at a very low stage of the water the author examined this portion of the river very carefully, noting the character of the banks, the nature of the material composing them, and other points of interest; 800 miles of the Missouri River have also been examined in a similar way. It is believed that these surveys furnish the first opportunity for an accurate determination of the amount of erosion along the banks of the river. A map accompanying the paper showed the oscillations of the river between the extremes of 1768 and 1893, and shows that they are really confined to rather narrow limits.

At Coles Point, when, in 1884, a cut-off occurred, the width of the neck of land was nearly the same as it was over 100 years earlier; but when the active erosion began a few hours was sufficient to cut a deep channel through which is now the main river. Many attempts to hasten this cut-off by ditches had been made, but the river did not follow the lines of the

ditches when the cut-off finally occurred. Attention was called to the pertinacity of deep indentations and projecting points which have retained their identity, although the entire bank line receded several hundred feet. This being true, it may be urged that the similarity of the bends and apparent stability of the islands furnish little or no proof bearing on the movements of the river; that is, the large islands might move bodily down the stream or laterally for long distances. Furthermore, we know that the heads of islands are eroded and accretions made at their lower ends. It is, however, evident that the rate of this movement is not so great as is generally believed. High trees which have withstood the floods and encroachments of the river for scores of years show plainly the comparatively narrow bounds within which the river moves.

The term erosion implies a steady wearing away, and this is in some cases fulfilled, generally where changes in the bank are rapid. No great amount of caving occurs at high water. This occurs mostly during the falling stage of the river from a little below the medium stage down. The banks, which may be composed of sand and silt, with horizontal layers of clay, become saturated with water during the high period, and this flows out when the river falls and carries much sand with it. As a result it sometimes happens that a mass 200 ft. or more in width and perhaps one mile in length will settle bodily downward several feet. This mass is finally broken up and disappears. Cut-offs are not usually made from scour at the top. Necks of land are usually built up by deposits; hence these frail barriers sometimes stand for many years, and finally break through by the undermining process, which washes out a layer of sand below the surface and is the immediate cause of the break. The excessive slope in the break when it is once made is an important element in its rapid enlargement. In November, 1891, a portion of the river bank near the French Market of the city of New Orleans, 1,600 ft. long and 250 ft. wide, settled, and the surface became broken and uneven. This subsidence amounted to 5 to 10 ft., and finally ceased, and has not increased for a long time. Borings in this vicinity show a stiff clay for about 50 ft. deep and a stratum of sand about the same thickness below it.

The maximum rate of caving occurs from Cairo, 620 miles down stream. At the left bank, at Newton Bend, it reaches 224,000 sq. yds. per annum for each mile of length; the area of greatest caving coinciding with the leveed portion of the river. Active erosion is greatest when the river is within its banks, and is, consequently, not influenced or controlled by the levees. How, then, can the levee affect the influence of the bank erosion? It is more than probable that the locality of excessive erosion is moving slowly. Profit Island, 815 miles from Cairo, is the farthest down stream of all the islands, and occupies the same position it did 125 years ago.

The maps show that excessive curvature and excessive erosion are rarely coincident. Hence we might expect, if the curvature could be increased so that the strength of the bank and the energy of the water should finally be in equilibrium, perhaps a curve of stability would be established where erosion would practically cease. The author does not think that cultivation of the adjacent land has much to do with the process of erosion. During the war Gen. Grant attempted to make a cut-off several miles below Vicksburg. The canal was dug wide and deep, and considerable water flowed through it, but it was not until 13 years later that a cut-off was made without any artificial aid about two miles below Grant's Canal.

It was found that in 885 miles of river there were 916 miles of caving banks, including the islands. The total area of caving per annum is 39,000,000 sq. yds., and the average annual rate of caving per mile is 44,186 sq. yds., or a little over nine acres. The average depth of erosion is about 66 ft.; hence, the annual volume of erosion per mile of river is 972,000 cu. yds.

Both banks of the river rarely cave in the same locality at the same time; erosion on one bank is usually followed by an accretion on the other. The accretion sometimes exceeds the erosion. The total annual amount of solid matter passing New Orleans in suspension is computed to be about 10 sq. miles, 26.8 ft. deep, or less than one-third of the amount of erosion, the remaining two-thirds go to build up the bars which obstruct navigation, and the points which follow the caving bends. It is plainly evident that bank erosion is one of the principal features in a solution of the problem of river improvement and control. If contraction works are built the erosion becomes active on the opposite bank, and the river soon moves beyond the sphere of influence of such works. If levees are built, they are often quickly destroyed by caving into the river, and new lines must be construced to restrain floods. On the other hand, active erosion furnishes abundant material to build up the artificial banks where channel contraction is required. This action is very much slower on the upper Mississippi, above the mouth of the Missouri, as the sediment in the water is much less.

This paper will be discussed at the regular meeting on Sept. 6

INTERNATIONAL RAILWAY COMMERCE CONGRESS.—We predicted some months ago that those who projected the series of International Congresses in connection with the World's Columbian Exposition would find that the material display at Jackson Park had greater attractions than any intellectual entertainment they could offer. Events seem to have proved this to be the case. At the recent Railway Congress we understand that the addresses were made to a very limited audience. Chairman Geo. R. Blanchard, in opening the Congress, reminded those present that though few in numbers, they represented the railways of the world—392,000 miles in extent. Little worthy of mention was brought out in the remarks preceding the reading of the papers except by the representative of the railways of Sweden, who, in presenting a paper on Swedish railways, prefaced it by the following somewhat left-handed compliment to American railway practice:

> When reading this paper through I found that the writer had omitted two very important points in treating this subject. He said nothing about the speed of our trains at home, and he has said nothing about the accidents on Swedish railways. Now he has probably omitted those two points for the reasons that they carry with them very little interest to American people, simply because the speed of our trains would not satisfy an American—a flying American—and the wrecks are so few that traveling on Swedish railways would be of little interest to an American.
>
> I have been in Sweden for some 30 years, and I have never yet heard of but one wreck in that country. I have been in America about four months altogether, and I have nearly lost my life three times on the American railways. Now this seems to me to be very interesting, and I would not for anything in the world have lost those chances of losing my life.

We published last week one of the papers of most interest to our readers, on railway construction in Central and South America. The following are abstracts of some of the other more important papers presented:

Governmental Regulation of Transportation and Its Practical Effects.

In the paper on this subject, by Mr. John W. Cary, General Counsel of the Chicago, Milwaukee & St. Paul Ry., the governmental control or regulation of railways owned and operated by private corporations only, as in America and England, was discussed. In these countries, in order that an individual or corporation may construct and operate a railway, it is necessary for him to receive from the state certain grants and franchises of immunities and privileges. Such franchises are public grants, and clothe the property constituting the railway with a public use. It gives it a semi-public character and subjects it to the regulation and control of the government, in behalf of the public, to the extent that its charges must be reasonable, and its management safe and convenient for the accommodation of the public.

The only object that the government can have in such a matter is to protect the public in their just rights. When this protection is secured, governmental regulation and control cease. The only rights of the public in that respect are that the railroads should be properly, safely and conveniently operated, and for a reasonable compensation. The public has the right to the use of the property for a reasonable compensation, and that its operation shall be safe and convenient to them. It has no right to manage or operate the road. The public has no claim to be served at less than a reasonable compensation to the owner for the use of the property and in a manner reasonably convenient and with safety. The owner, as such, is entitled to that compensation, the control and management of the property, and an act of the Legislature that deprives him of it or any portion of it is a violation of his vested rights, and a taking of his property without compensation or a due process of law. Manifestly, therefore, the extent of the power of the government to control railways is to secure for the public the proper, safe and convenient operation of the roads for a reasonable compensation. When these objects are accomplished, the function of the government in the regulation, control and management of railways owned by individuals is accomplished. The public rights are fully secured and the government has no further control over railway property than it has over property not attached to a public use.

The only right which the public can claim or the legislature or state enforce in regard to the price to be paid for the use of private property clothed with a public use, or its management or operation, is that the owner should be restricted to the charge of a reasonable compensation and reasonably convenient and safe operation.

It may be assumed as established by our highest courts that legislative or state control of railways in this country is established to the extent that the state, through its legislature or otherwise, is entitled to require that all shall be operated by the owners for a reasonable compensation, and that the state may make all suitable and proper rules and regulations to require the company to fix such rate. That the company is the owner, and as such is entitled to manage the property and fix the rates of charges subject to these rules and regulations, and such compensation must be a reasonable remuneration to the owner, for the use of the property, as well as just and reasonable to the public, and that in case the rules and regulations in that respect fixed by government are challenged as unreasonable or unjust, the ultimate remedy for the party aggrieved is by an appeal to the courts. In other words, that the question of reasonable compensation in such case is for the courts, and not the legislature, for final determination.

The practical effect of governmental regulation of transportation is very difficult to estimate correctly at this time. The efforts of all governmental control of railway charges has not been a success generally, as is witnessed by the repeal of the Granger laws, and later the Minnesota railway commission law, and by the dissatisfaction with the Iowa railway commission law, which is now the only law regarding rates that is being actively enforced. Governmental control, in some other respects, as in preventing unjust discrimination and privileges, has been much more successful. There is no doubt that the general authority reserved to the government over railways to regulate and control them to the extent that they shall be operated for a reasonable compensation is of great benefit to the public, and a wise provision of government when limited as the court has now fixed its bounds. The efforts to enforce these provisions have often been unwise, and operated to the injury of both the railways and the community in which they were made. A wise administration of these reserved powers would not injure the companies, and in some cases would prove beneficial to the community, but any attempt on the part of government to fix the compensation to be paid for the services of railways is likely to prove a failure in the future, as it has in the past.

Constitutional Guaranties of Railway Property, Rates and Franchises Against Legislative Spoliation.

The paper on this subject, by Mr. John F. Dillon, General Counsel Union Pacific Ry., had for its theme to show that the Fourteenth Amendment to the Constitution protects railway properties, franchises and rates from legislative spoliation by the states, and that the Fifth Amendment, in connection with the limited powers of the general government under the Constitution, gives like protection against the legislative power of Congress. The general trend of the arguments advanced was similar to that of the paper on governmental regulation by Mr. Cary. The conclusion arrived at was that the constitutional amendments mentioned provided against the fixing of unreasonable rates either by Congress or the state legislatures, and placed the decision as to their reasonableness in the Supreme Court of the United States.

Railway Strikes: What Should Be Done in the Way of Prevention and Control.

In opening his paper on this question, Mr. E. W. Meddaugh, General Counsel Grand Trunk Ry., stated that the terms and conditions on which the wage earner will render his services to a railway company must be the subject of agreement, as in the case of other employers of men. While recognizing the right of employees to combine to improve their wages and conditions and the great advance in prosperity and usefulness which had resulted from such combination, there were at present no legal restrictions on the power of such combinations to violate at will any agreement entered into between them and the railway companies. Thus the men, while demanding all negotiations to be carried on with the officers of these combinations, gave no legal guaranty that the agreement arrived at would be conformed to. This was manifestly unjust. There was at present, and had been for many years, certain stringent laws regulating the relations between vessel owners and the men employed by them in navigating their vessels, and providing ample redress for either party in case of the violation of these relations by the other party. Similar laws should be enacted and enforced respecting railway companies and their employees. The laws should embrace all railway employees in every department of the service—the mechanic who repairs the engine and the cars, the switchmen and others who have any duty to perform in connection with the movement of the power or rolling stock of the company, the men engaged in handling freight, in loading it into or discharging it from the cars, or in receiving it into or delivering it from the carrier's warehouse; and they should also embrace all persons who handle or carry the freight between the carrier and the shipper or consignee. They may, and properly should, go one step further, and provide that any act of persons not in the service of a railway company, in aid or abetment of others in obstructing this commerce, shall be punishable even more severely than a similar act of the em-

ployees themselves. A great part of the embarrassment heretofore experienced by railway companies from strikes has come from the interference of an outside lawless element. Persons of this worthless and idle class of the community are usually guilty of the acts of vandalism which were heard of in connection with railway strikes, and not the railway employees.

In connection with this legislation, Congress should prescribe the duties of these railway companies toward their employees in respect of devices and appliances for protecting them from personal injuries, etc. The subject is clearly within the province of the national legislature. In recognition of this an act was passed near the close of the last Congress which makes it incumbent on railway companies to equip their engines and cars with automatic couplers and power brakes within a prescribed period of time. This was for the protection of employees. Other and further legislation in the same interest may be necessary. Congress, having the undoubted power to cover the entire field, involving the reciprocal rights and duties of railway companies and their employees, and of the duties of both to the public, should unhesitatingly employ it.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The 65th meeting will be held at Chicago, Ill., beginning Monday, July 31, 1893. This meeting will be held in two sections, held separately and simultaneously (except when joint sessions shall be deemed desirable), and constituting Divisions C and D of the International Engineering Congress, representing respectively Mining and Metallurgy (Eng. News, April 20). Headquarters will be at the associated engineering headquarters, to Van Buren St. Chicago, where members attending the meeting are expected to register upon arrival, and will receive cards of admission to the sessions of all divisions of the congress, and to the engineering headquarters in the Mines and Mining Building at the Exposition, from Mr. Max Schmidt, Secretary of the General Committee of Engineering Societies.

The opening general session of the congress will be held on Monday, July 31, at 10 a. m., in one of the large halls of the Art Palace, Lake Front Park, Chicago. (This is in the business part of Chicago, near the headquarters at 10 Van Buren St.) The sessions of the several divisions will be held in different halls in the same building during the forenoons of Monday, Tuesday, Wednesday, Thursday and Friday of the same week (the Monday session following the general opening session). The congress will terminate with a general closing session on Saturday, Aug. 5. The afternoons will be devoted to visiting the Exposition, etc., or to extra sessions if necessary. Programs will be issued by the general committee in charge of the congress, and may be had at headquarters. The following papers have been secured, chiefly by invitation of the Council:

Division C, Mining Engineering.—"The Detection and Measurement of Firedamp in Mines," Prof. G. Chesneau, Paris, France; "Hydrogen-Oil Safety Lamp," Prof. Frank Clowes, Nottingham, England; "Experimental Investigations on the 'Loss of Head' of Air Currents in Underground Workings," D. Murgue, Besseges, France; "Tests of Hydraulic Cements," Prof. H. Le Chatelier, Paris, France; "Genesis of Ore Deposits," Prof. Franz Posepny, Vienna, Austria; "A Remarkable Deposit of Ores of Wolfram in the United States," Dr. Adolph Gurit, Bonn, Germany; "Geological Distribution of the Useful Metals in the United States," S. F. Emmons, Washington, D. C.; "Lead and Zinc Deposits of the Mississippi Valley," W. P. Jenney, Deadwood, So. Dak.; "Origin of the Gold-Bearing Quartz of the Bendigo Reefs, Australia," T. A. Rickard, Denver, Colo.: "The Bertha Zinc Mines," W. H. Case, Bertha, Va.; "Improvements in Ore Dressing," Oberbergrath O. Bilharz, Berlin, Germany; "Handling of Large Quantities of Iron Ore," John Birkinbine, Philadelphia, Pa.; "An Improved Hanging Compass," Guy R. Johnson, Longdale, Va.; "Mining and Mineral Statistics," C. Le Neve Foster, Llandudno, Wales; "Utilization of Anthracite," Eckley B. Coxe, Drifton, Pa.; "Coke and Natural Gas," Jos. D. Weeks, Pittsburg, Pa.; "Mining Schools," Prof. S. B. Christy, Berkeley, Cal.

Division D, Metallurgical Engineering.—"Microscopic Metallography," F. Osmond, Paris, France; "Micro-Structure of Ingot Iron in Cast Ingots," Prof. A. Martens, Berlin, Germany; "Segregation and Its Consequences in Ingots of Iron and Steel," Alexandre Pourcel, Paris, France; "Micro-Structure of Steel," Albert Sauveur, So. Chicago, Ill.; "Review of American Blast Furnace Practice," E. C. Potter, Chicago, Ill.; "New Direct Process for the Production of Pig and Refined Iron," Alexander Sattmann, Donawitz, Austria; "Sulphur in Cast Iron," W. J. Keep, Detroit, Mich.; "The Bessemer Process as Conducted in Sweden," Prof. Richard Akerman, Stockholm, Sweden; "The Open-Hearth Process," H. H. Campbell; "Blowing Engines," Julian Kennedy; "The Limitations of the Stamp Mill," T. A. Rickard, Denver, Colo.; "Experiments on the Specific Gravity of Gold Contained in Gold-Silver Alloys," Henry Louis, Singapore, Straits Settlements; "Summary of American Improvements and Inventions in Ore Crushing and Concentrating, and in the Metallurgy of Copper, Lead, Gold, Silver, Nickel, Aluminum and Zinc," James Douglas, New York, N. Y.; "Improved Slag Pots," H. A. Keller, Butte, Mont.; "Consumption of Fuel in the Taylor Gas-Producer Plants at the Aspen and Marsac Mills Compared," C. A. Stetefeld, San Francisco, Cal.; "Electric Welding," Edgar C. Moxham, Pulaski, Va.; "Alloys of Iron," R. A. Hadfield, Sheffield, Eng.; "Heat Treatment," H. M. Howe, Boston, Mass.

Persons desiring to make contributions in discussion of either of these papers are requested to notify the undersigned at once. Some of them are already in print, and it is expected that all will be printed before the meeting. Members or others desiring copies in advance, for use in preparing contributions to discussion, will be accommodated as far as practicable, upon application to the Secretary. Copies so sent are to be regarded as confidential until Aug. 1, 1893. It is expected that the papers will not be read at length at the sessions, but presented in brief abstract only, and that most of the time will be available for discussion. In the allotment of time for discussion, preference will be given to those who have previously notified the Secretary of their desire, and to the presentation of written contributions. R. W. Raymond, Secy.

AMERICAN INSTITUTE OF ARCHITECTS.—The annual convention will be held in the new Memorial Art Institute, on the Lake Front, in Chicago, in the week beginning July 31, 1893, and the Grand Pacific Hotel has been selected as the headquarters of the Institute during the convention. The following papers have been promised for presentation at the convention:

On the World's Columbian Exposition.—"Story of Its Organization," Daniel H. Burnham; "The General Scheme and Plans," Frederick Law Olmsted; "The Construction of the Buildings, Docks, Piers, Bridges, etc.," E. C. Shankland; "The Use, for Transportation, of the Lagoons of Lake Michigan, of the Intramural Railway, of the Chicago & South Side Elevated Ry., of the Great Trunk Lines, of the Terminal Facilities, of the Chair System, etc.," W. H. Holcomb; "The Mechanical Power Plant," Charles F. Foster; "The Electric Plant," R. H. Pierce.

On Subjects of General Architectural Interest.—"A Review of Chicago's Architecture," Frederick Baumann; "Engineering in Architecture," L. de Coppet Berg; "The Influence of Building Laws Upon Architectural Development," C. H. Blackall; "Ethics in Architecture," A. J. Bloor; "A Review of Recent Plumbing Practice," Glenn Brown; "Association for Mutual Defence," T. M. Clark; "Architectural Engineering," Thomas C. Clark; "Superintendence in Architecture," R. W. Gibson; "Foundations of Buildings," William R. Hutton; "Government Practice," Jeremiah O'Rourke; "The "Aeration of Cities and Their Buildings," Edward T. Potter; "Library Buildings," J. L. Southmeyer; "Some Considerations Affecting the Development of Characteristic Style in the United States," Henry Van Brunt; "The Use of Color in Architectural Design," H. Langford Warren; "Fireproof Construction and the Practice of American Architects," P. B. Wright.

Alfred Stone, Secy.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on June 3, the discussion of improving the present status of the engineering profession was opened by the secretary reading, at the request of Mr. Horace W. Sellers, a paper on that subject by Mr. H. F. J. Porter, which was presented at the last November meeting of the American Society of Mechanical Engineers. He especially called attention to the desirability of making the professional degrees really indicate to the general public the capability of the engineer who used them, by having them conferred by a Board of Regents, embodied with power to confer titles for merit. It should be capable of judging what a man should know in order to bear a title, should endeavor to bring to unity all methods among the schools as to an engineering education, and should confer titles after a term of practice and after passing an examination, upon those entitled to them, thereby practically licensing the recipient to practice. It would not be absolutely necessary to attend a technical school to obtain a title, as a self-taught genius, proving himself capable, would be awarded one. A more natural division of the different branches of engineering was suggested, with a recommendation that the province and duties of the engineer in each division should be well defined, and that the practice of a man should be confined to those divisions in which he is competent and licensed to practice. It was thought that this matter might profitably be taken up at the Engineering Congress in Chicago next August, and that the General Committee might act as the Board of Regents above mentioned.

Mr. Birkinbine stated that the tone of the general discussion which this subject had received in the technical journals tended to bar out from the use and benefits of a degree those who had not received one as the result of a college education, and that such a plan would work a great injustice to the self-made engineer, whom engineering societies and the world at large had in the past seen fit to honor.

Mr. G. Bacon Price called attention to one point of difference between the other learned professions and that of the engineer not generally considered—namely, that the community had not yet come to realize its need for the intelligent engineer, as it did for the doctor and the lawyer, for example, and that there was not at present a demand for their services to in anywise meet the numbers turned out by our technical schools. Whether a man has a degree or not, if his services are necessary and efficient his reputation will rise accordingly. Most of our young engineers, however, find it necessary to associate themselves with corporations or in partnerships in order to obtain a sufficient practice. L. F. Rondinella, Secy.

ENGINEERS' CLUB OF CINCINNATI.—At the last regular meeting of the club Mr. W. B. Ruggles read a paper on "Building Stones in the Vicinity of Cincinnati," which contained much of interest and value in information and statistics in reference to the quality and characteristics of the stones found in the quarries within a radius of about 100 miles from Cincinnati, and of the various uses to which they had been put and were adapted. Mr. J. H. Lawton, who had been connected with the work, engaged the attention of the club with an interesting account of the construction of the Niagara Falls tunnel, which was built as a part of the plant of the Niagara Falls Power Co., and the Cataract Construction Co., for the utilization of the falls for the development of hydraulic power for industrial purposes. J. F. Wilson, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on June 7, in the absence of Professor Howe, Mr. E. Flad read a paper of the evening on "The Hinged Suspension Bridge," giving the full methods and diagrams for making all the calculations in suspension bridges. Mr. Crow presented an interesting description of a dry kiln heated by steam which had caught fire at the top of the roof. Arthur Thacher, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF MINNEAPOLIS.
July 6. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 7. Secy., F. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 7. Secy., O. Von Geldern, 719 Market St., San Francisco
MONTANA SOCIETY OF CIVIL ENGINEERS.
July 8. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
July 10. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
July 10. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
July 11. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
July 11. Ryan Hotel, St. Paul. Secy., W. D. Crosman.
NORTHWESTERN SOCIETY OF ENGINEERS.
July 11. Secy., D. W. McMorris, Burke Block, Seattle, Wash
DENVER SOCIETY OF CIVIL ENGINEERS.
July 11. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
July 12. Wichita, Kan.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
July 13. Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
July 13. Secy., W. G. Kirkpatrick, Nashville, Tenn.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
July 14. 201 Washington Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
July 14. Secy., D. W. Meeker, St. Paul.
ENGINEERS' CLUB OF PHILADELPHIA.
July 15. 1122 Girard St. Secy., L. F. Rondinella.
SWEDISH ENGINEERS' CLUB.
July 15. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
COLUMBIAN ENGINEERING SOCIETY.
July 15. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
July 18. Secy., R. H. Clark, Pittsburg.
ENGINEERS' CLUB OF ST. LOUIS.
July 19. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF CINCINNATI.
July 20. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
July 20. Secy., C. F. Franson, Portland Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
July 28. Secy., C. H. McLeod, Montreal, P. Q.
AMERICAN INSTITUTE OF MINING ENGINEERS.
July 31 to Aug. 5. Chicago, Ill. Secy., R. W. Raymond, 18 Burling Slip, New York.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. Collingwood, 127 East 23d St., New York.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. R. Hutton, 12 W. 31st St., New York.
WESTERN SOCIETY OF ENGINEERS.
Aug. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' SOCIETY OF PHOENIXVILLE.
Sept. 5. Secy., W. Halliburton.
NEW ENGLAND RAILROAD CLUB.
Sept 13. Secy. F. M. Curtis, O. C. R. R., Boston.
WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept 21. Secy., S. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.

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AND

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The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U, Posts 10 to 12, of the Transportation Building Annex, at west end of Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:30 a. m., of each week day, and from 10:30 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

An innovation in the employment of an engineer to take charge of the building of a county bridge is noted in one of our exchanges, the "Knoxville Herald." A Mr. C. H. Jones is appointed by the bridge committee to make a survey of the site, locate the piers and design all the substructure. He is to be paid the not extravagant salary of $125 per month, but he was required to give a bond of $10,000, with ample security, to hold the county blameless for any mistakes that should occur in his work. This is rather an extreme case, and the conditions under which the bond is to be cancelled are not stated. The presumption is that the mistakes referred to are palpable engineering blunders in the span and general dimensions; but as an even more serious error of judgment might occur in the method of founding the piers, it is evident that a bond of this nature would have to be very carefully drawn to meet all the conditions of the case. The one point gained, however, by the bridge committee is the services of an engineer who believes that he is thoroughly able to carry out the work entrusted to him and has sufficient local reputation to induce two responsible citizens to go upon his bond for a considerable amount of money. It is a movement in the right direction, and the first effect of a bond of this nature would be to materially reduce the list of "engineers" applying for the position. It also relieves the local committee, to some extent, of the responsibility of deciding who is a competent engineer, and in this respect is much safer to the taxpayer than the too common assumption of a knowledge rarely possessed by committees of this nature. The new rule is one that could be followed with profit in many cases; provided, that the terms of the bond provide for a competent engineering referee and are not so drawn as to work possible injustice to a man who is really fitted by education and training to carry out the work entrusted to him.

The results of the investigation of the recent accident at Parkville on the Long Island R. R., noted in our issue of June 22, remind one of the old saying:

> For want of a nail the shoe was lost.
> For want of a shoe the horse was lost.
> For want of a horse the rider was lost.
> For want of the rider the battle was lost.

For lack of a detector bar on a derailing switch a train was split upon it after the locomotive and three cars had passed safely over. More in detail the facts brought out by the investigation were as follows: Derailing switches are placed at the points where the tracks of a double-track road are gantleted to pass through a tunnel only wide enough for a single track. The gantleted section was properly protected by signals, derails and interlocking apparatus. The detector bar on the derailing switch which prevents its being thrown under a train was taken off some months ago for repairs and had not been replaced. On a hot June afternoon the signalman fell asleep and was awakened by a passer-by just as a crowded train from the race tracks approached. In the confusion of his first waking moments he pulled the lever of the derailing switch as the train was passing over it and the derailed cars at the rear of the train went crashing against the tunnel walls. There would have been no fatalities, however, had the cars been of the ordinary type. But they were open cars with running boards on the sides, on which many passengers were standing. It was among the passengers riding in this highly dangerous place that the deaths and serious injuries occurred. The train was running at a slow rate when the derailment occurred and none of those seated inside the cars were seriously injured, notwithstanding the light construction of the cars.

From a common-sense standpoint the responsibility for the fatalities is divided among the railway company which delayed putting its interlocking apparatus in a perfect condition, the switchman who slept while on duty and the victims of the accident who persisted in riding in a dangerous place notwithstanding warnings. It is exasperating, indeed, to have the coroner's jury under such circumstances place the whole blame upon the railway company; yet the probabilities are that their verdict would be sustained in court. The theory of the law court is that the railway is in duty bound to use good appliances for securing safety to its passengers and employees. Cases of forgetfulness and neglect will occur to a greater or less extent in any large body of men, and the railway is bound to make reasonable provision to meet these cases.

That this theory of law, unjust though it may seem to some, is the correct one, is being shown more and more by experience. Inventive ingenuity is all the time perfecting new methods of eliminating the factor of personal unreliability and new devices for doing automatically what has before required human interference. That there is a tendency to underestimate the importance of these devices simply because they are of use only under exceptional circumstances is well shown by the neglect of the Long Island R. R. Co. to replace the detector bar on the switch that caused this accident. A more forcible illustration of the fact that it is unsafe to neglect safety devices could hardly have been given.

In a late issue passing mention was made editorially upon the desirability of carrying light freight as well as passengers upon electric suburban railways. As the chief purpose of the majority at least of roads of this description is to develop travel in certain sections and directions, and to this end to increase the conveniences of those who may reside along the route, there is no doubt as to the popularity of an innovation of this character, and of its ultimate profit to the company adopting it. These suburban lines of considerable length are usually not so crowded with passengers but what some space could be reserved for carrying light parcels; as time of delivery is not so essential as the fact of a delivery with least inconvenience to the residents, special freight cars could be run in the morning and evening hours. It is suggested that the chief difficulty is a legal one, and that in nearly all cases the charter permits the carriage of passengers only. If this be so, it is time that incorporators looked a little ahead and secured the privilege of carrying light freight in addition to that of carrying passengers. Electric railways are here to stay, and the feature recommended would undoubtedly in many places extend their field of usefulness and profit and at the start possibly make the difference between profit and loss in the operating accounts.

The short article recommending the use of the polar planimeter in estimating quantities in railway construction, elsewhere given in this issue, is worthy of special note by many hard-worked engineers. While our correspondent makes no mention of the comparative time expended in obtaining the areas in the old way and by the planimeter, it is evident to any one familiar with the use of the latter instrument that the saving must have been very considerable. The percentage of differences found is small and is practically of little moment in original and monthly estimates. As a labor and time-saving device in all cases of complicated cross-section there is no doubt that this wonderful little instrument could be much more widely used than it is, and the comparison of actual results given by our correspondent shows what can be accomplished with it by careful work.

THE IDEAL ENGINEERING SCHOOL.

VI.

The actual methods of instruction in fieldwork are given quite fully in the subjoined reprints of information gathered from two representative colleges, one Eastern, one Western. As we are going to criticise and object to them it is but fair that we should give them quite fully. The general characteristics of the methods employed are still almost universal in our engineering schools, and may be thus summarized:

The aim of the instruction is throughout individual, from the professor to the student; never from one older student to another. It is also to teach the several processes to each student as so many bits of theoretical knowledge; never to pursue the instruction so that each student may by much practice know how to do any of the several processes WELL. That skill is left to be acquired in after life. The student is in effect taught to turn an angle or chain a distance as a military cadet might be separately taught by an instructor to go through the motions of the manual of arms. When he has been taught as an individual to "present arms" and the like, the process of instruction is dropped. The student has then "been through" that much. Of subordination of one man to another, of the men of one class to the men of another, of use of the older men to instruct the younger men, and in so doing to instruct themselves in managing a party, there is not a trace. On the contrary, any sort of subordination of one man to another is carefully avoided. When it is in a measure unavoidable, as in most kinds of fieldwork, it is reduced to a minimum and its possible advantage to the student almost destroyed by (1) never mixing men of the different classes together; (2) rotating them in office frequently, so that each alternately is the head and foot of a party, and (3) making the field exercises short, so that no man has done much more than put the harness on before he may take it off again. His tender skin is not galled by any real work.

The consequence is that the average engineering student graduates are greener than grass in the practical work of field engineering and surveying, despite their college practice. They must perforce begin at the foot of the ladder. They do not stay there long, because they are bright young fellows; but they stay there long enough to lose unnecessarily at least two years, as we have stated.

Nevertheless, we do not object to these methods of instruction on account of this loss of time primarily, though two years is a great deal to lose out of a young man's life, but because the whole character of the man as a future engineer suffers by this defective system of instruction. Whether he remains through life an engineer or branches off into contracting or manufacturing or railway management or teaching at an engineering school, his lot through life is either to obey or to command, and generally both at once. His lot through life is to be continually rubbing up against other men and having to get along with them somehow (and that not as an equal, but either as a superior or inferior), or prove a failure and have to step down and out. Engineering fieldwork and the manifold practical

exercises which may be made to depend thereon furnish the best of all methods for giving some practical training in this great art, as also in the art of doing the things well which he is most likely to have to do first after graduation, as also for engraving on the student's mind the great and fundamental truth that engineering is primarily the art of doing things and not of knowing things—and this grand opportunity is now wholly neglected at most schools, and nearly so at all.

In order that it might be fully availed of we would organize an engineering school as follows: About eight months of the year, say, 32 to 34 weeks, should be devoted chiefly to instruction in the advanced theory of scholastic engineering as now, only that more scholastic work than now could in fact be done in these eight months, and vastly more good derived from it. Of the remaining 18 to 20 weeks not more than 4 to 6 at most should be devoted to absolute idleness, leaving some 14 weeks or so which for the most part should be spent literally in the field, by going into camp, for the manifold purposes of giving more pleasure to the students, developing their physique and habits of order and neatness, reducing expenses, making it easier to move the men about from place to place, and teaching many of the students practical methods of camp life which they will have occasion to apply directly later.

The "glorious fun" which Birdofredum Sawin failed to find when campaigning in Mexico, he would surely find in an engineers' camp in the White Mountains or Adirondacks, or any like region if he had a spark of manhood about him and any desire to become an engineer. Three months a year of such life as this, filled with the varied work (not "exercises," but real engineering work) which might be included in it, would not be regarded by the students as a burden, but as the great pleasure of the year. The coming freshman class would be only too glad to enter in June instead of October, and thus get this three months' training in practical fieldwork before they began their studies, and they should be encouraged to do so, preferably by requiring that each man should have his four-years of camp life as well as of study before he graduated.

These camps should on no account be made up of men of one class only. The freshmen should be axemen and chainmen and nothing else throughout the whole summer; the sophomores, head chainmen and rodmen; the juniors, instrumentmen, and the seniors topographers and chiefs of party. The professors should on no account assume the latter office; they had much better go to Europe and let the boys work out their own salvation, being held responsible for results. Is it said that they could not be controlled in that way without constant supervision? Perhaps they could not at the present moment, under present methods of prior instruction, but they can readily be trained to it. The entire responsibility for the party, its work and its movements, should be centered absolutely in the senior holding the office of chief of party, and he should hold it during good behavior during the entire season. What is more, should he prove unfaithful or incapable, he should not be degraded in his own party and another member of it put over his head. That is productive of jealousy and destructive of discipline. He should be detached and detailed to another party, and the gap filled by promotion of the most deserving man available in any party; and so with any subordinate member.

A sound prior training for three or four years would make this a much dreaded disgrace, and a chief thus trained might be trusted to get more work out of the party and to teach the younger men more of the particular work in hand than any professor can directly. The function of the latter and his assistants would then become analogous to that of a chief engineer and his assistants in service. It often falls to the lot of the latter to keep from two to twenty widely scattered parties going, by moving from one to the other as often as he can. A professor, not tied down to the exigencies of practical life, could scatter about two to ten parties within 10 or 12 miles of each other and visit each every two or three days.

The work done by these parties should be actual, finished work, including, for example, a complete survey, mapping, estimation and designing of structures for 10 or 20 miles of railway or canal, or a mapping of a considerable area. We cannot now attempt to elaborate in detail the best methods of managing such work, but it should be such as to give a large amount of practice in quick mapping and computing as well as fieldwork, and also in the locating and designing of structures, especially minor structures. And all the work done should be actual, finished work, capable of record and preservation, and so far as possible, of use in the subsequent work of instruction, or in the next year's fieldwork. The expense of outfitting these parties would be merely nominal after the first year; the expense of running them merely the cost of food, the wages of a cook, and an occasional teamster.

So far as possible, the same methods should be used in the weekly field exercises during the months given chiefly to study. Except that some relief in the direction of physical exercise is desirable during the studious months, all such drill might much better be omitted, and transferred to the summer term, as two-hour lessons are hardly the best way to teach practical fieldwork; but to the extent that this intermittent instruction is retained the men of the senior classes should direct the work of the juniors for their mutual benefit. The professors could then keep more in the background.

We will now see what is done at our colleges in this direction. The following is from a representative and very excellent Western college:

In land surveying two or four constitute the party; generally the latter, two being principals and two assistants. In transit surveying and leveling two make a party. In topographical surveying two to eight according to the kind of work in hand. In all of the above a professor and an assistant have immediate charge of all the parties. For this work we have a specially prepared area, which makes the checking of results very easy. All of the above comes in the sophomore year, and occupies two hours each day—over two, in fact.

In the junior year, in railway surveying, eight to ten constitute a party, according to the size of the class, under the direction of a professor or an assistant for each party, a professor always being in general charge. The time is 2+ hours when running curves and a day at a time when running lines. Every student goes out every clear day, nominally.

In the senior year, in practical astronomy, two men constitute a party under the direction of a professor; two hours is the time; the student is out every other day.

In no case are two college classes combined for field practice.

I wish I had time to discuss the relative merits of fieldwork on the above plan, and the plan of a summer school in the field.

We too wish he had had time, and we hope he will now take time to think the matter over carefully, and with the premises that the two methods are not necessarily in conflict with, but supplementary to, each other.

The following are the more pertinent parts of the prospectus of a prominent Eastern college. It will be seen to read very well indeed; almost as if the general methods of the school were much the same as we have advocated. In reality, however, this is not so; and we add notes explaining why it is not so.

The instruction is given by lectures and recitations, practice in the field, and exercises in the drawing-room. The constant aim is not only to make the student thoroughly familiar with the principles on which all sound engineering must be based, but to illustrate the application of those principles in such detail that he may clearly appreciate their use, and their relation to practical work. While it is recognized that most matters of mere practical detail are best and most quickly learned through experience in actual work, and while it is believed that the particular province of a higher school of engineering is to develop in the mind of the student, first of all, a clear perception and a proper appreciation of what may be called the theoretical side of engineering, yet it is deemed equally essential that the practical application of these principles shall be so clearly pointed out and so frequently illustrated and enforced that the student shall be able to make intelligent and prompt use of his knowledge whenever occasion arises. It is believed that only by teaching theory and practice together can proper results be obtained, and the student be made clearly to see their connection. In each branch of instruction it is sought to acquaint the student with matters of fact and of detail to an extent sufficient to enable him to enter at once upon the practice of his profession, and to render him capable of filling any position that would be offered to one just completing a four-year course.

In surveying, fieldwork classes are divided into small parties of from two to five students, and an instructor is assigned to each party. The work is thus carried out under careful supervision, and without loss of time. In order to secure further economy of time, each class devotes an entire day in each week to fieldwork, during favorable weather.

The work in surveying and topography extends through the second and third years, and is followed by geodesy in the fourth year. During the second year one day per week throughout the year is devoted to fieldwork and drawing, together with classroom exercises. (Precisely what this sentence means is not clear.—Ed.) Great stress is laid on the early acquirement of rapid and accurate habits in the use of instruments, and the keeping of neat field notes; and for this purpose the classes are divided, for work in the field, into small divisions, so that each student shall be constantly engaged, and shall have practice in all the manipulations. The fieldwork comprises the use of the chain, compass, transit, level, clinometer, hand level, aneroid barometer, solar compass, and the solar attachment to the transit; the adjustments of these various instruments; the astronomical determination of the meridian; leveling for profiles and contours; and practice in surveying without instruments. By dividing a large class into a number of sections, and assigning each to a separate portion of the work, problems of considerable interest and magnitude are sometimes undertaken. So far as possible, fresh problems are given each year. The results of the fieldwork are plotted in the drawing room, and the student is instructed in the methods of computing areas, latitudes, and departures; in the various problems involved in land, city and underground surveying, and in the methods used in the public land surveys of the United States.

The fieldwork of the third year includes the use of the stadia, sextant and plane table, and the operations involved in topographical and hydrographical surveying.

Topographical drawing is taught in the second and third years. In the second year the student is made familiar with the various conventional signs and methods of representing topography, the standards used being those of the United States Coast and Geodetic Survey. In the third year this knowledge is applied in making a map of a railway location.

Students taking the general option of geodesy receive, in the first term of the fourth year, a short course in practical astronomy, embracing an elementary discussion of the methods of determining latitude, longitude, time and azimuth, together with the theory of the usual astronomical instruments. This is followed, in the second term, by a brief course in geodesy, embracing a discussion of the figure of the earth, and of the methods of measuring base lines and of carrying on a geodetic survey.

In the early part of the vacation following the third year, students in civil engineering have the privilege of attending a summer course, which offers about four weeks of continuous field practice, thus affording more extended training in this direction than it is possible to give during the school year. Students taking the geodetic option are required to attend this course, but it is also open to all civil engineering students who have completed the third year, and to any other students who are properly qualified.

The object of this course is to furnish the special field training essential for students desiring to enter the government surveys or to engage in extended topographical work of a similar nature. It is not attempted to complete any particular piece of work, but to instruct the student, by actual practice, in the various steps incident to the progress of a complete geodetic survey.

Practice in topographical surveying by different methods occupies a considerable portion of the time, and emphasis is laid upon the economical adaptation of methods and instruments to different scales of topographical work. The plane table, the transit and stadia, the aneroid barometer and pocket instruments of various kinds are used and compared, and attention is paid to the freehand sketching of contours, for the purpose of bringing out special geological features.

Hydraulic field work constitutes an important part of the work of the summer course, and consists in measuring the flow of some stream of considerable size, using various methods and instruments, including floats and current meters of several kinds. The results of the observations are plotted and the computations of discharge worked out by the students during their fourth year.

Field work in geology and in the study and interpretation of topographical features constitutes another important part of the summer course. The class-room study of geology often fails to prepare for intelligent field work, and the aim of this portion of the course is to enable students to acquire correct perceptions through their own examination of natural features. The detailed study of several simple types of surface leads to the study of a diversified district, which the

student is taught to analyze into topographical elements of which it is composed, and to examine with reference to its geological structure, thus ascertaining to what extent and in what ways the superficial topography reveals the internal or concealed structure of hills and other features. By carrying on this work hand in hand with the topographical surveying, the student gains an insight into the true significance of the surface features which the topographer has to represent.

Railway engineering is taught in the third year to all students in the department, while in the fourth year advanced courses are given to students choosing the second or railway option.

The class-room work in the third year comprises a series of 60 exercises, and treats of the survey, location, construction and equipment of railways. It includes the topics of reconnaissance, preliminary work, location, curves and turnouts, the calculation and measurement of earthwork, the setting of slope stakes, the theory of easement curves, the construction of culverts, trestles and masonry, and the subject of track, comprising ballast, ties, rails, frogs, switches, crossings, turntables, etc.

The students are thoroughly drilled in the mathematical work involved in the subjects of curves, turnouts, spirals and earthwork, and are taught the use and construction of earthwork diagrams of various kinds.

In addition to the work in the class room, the students make each year the reconnaissance, preliminary and location surveys for a railway two or three miles in length, upon such ground as may best illustrate the problem occurring in practice. Field practice is also given in a variety of problems involved in running in curves and spirals, and in setting slope stakes. In order to carry on this work without waste of time one entire day in each week is devoted to field work; in the fall and spring, while the weather permits. In the drawing room, maps and profiles of the railway survey are prepared by the students, who are instructed in the methods of using the map and contours to fit the line properly to the ground. Additional practice in this direction is also given by furnishing the students with lithographed contour maps of a certain district, upon which they are required to locate a suitable line connecting two given points.

This reads well, and comparatively it is well, for both on paper and in fact it is more than most colleges give; but let us now review the reality. Taking up the last sentence first, the "lithographed contour maps of a certain district" are two or more unconnected sheets about 2 ft. long of topography, which the eye of an old hand instantly recognizes as bogus, i. e., as topography not constructed from notes but evolved off-hand from the inner consciousness of the draftsman. There is a certain regularity of irregularity about it which cannot be mistaken. No real fragment of the earth's surface ever had quite such a shape.

Well, perhaps this is allowable. It may be plausibly urged that the boys don't know the difference, and it gives them a little elementary practice; a chance to make a "paper location" covering some six curves at most! But is it not evident what a waste of instruction it involves to throw such a problem at a youth who has never seen compass put to paper for that purpose before? Good paper location is a difficult art. To have any real grasp upon its elements the youth ought to have watched the process many times before, as applied to ground which he had actually trodden over and knew the shape of. He would thus learn to correlate the map and the reality, and by the time he reached his senior year his eye would be so trained that he also could distinguish bogus from genuine topography, a useful and necessary art for the chief of a party, who is often imposed upon by a tired or incapable topographer.

Passing on backward, it is said that "the students make each year the surveys for a railway two or three miles in length," which is true literally, but not as respects any one particular student. He takes part in only one such survey during his course, and the method used is to start two parties from opposite ends of the "two to three miles" and run them toward each other till they meet, so that the practice of any one man in railway location is not specially great. We have been favored with some notes of the actual methods pursued on this survey, which are as follows, premising that a lithographed map covering the distance stated (but not the before-mentioned contour maps) is given to each student and covers a town district thickly covered with streets:

Reconnaissance.—This covers 2 to 4 miles. The entire class (30 to 50 students) accompanies the instructor. Attention is called to all points of interest, grade crossings are to be avoided, and all reasonable lines examined. Each student carries a map and finishes in ink later in office. The line is marked in pencil in the field.

While the length of line covered is not great, careful attention is given to all matters which would influence location, and the principle of carefully examining the ground and keeping your eyes about you is carefully enforced. The students generally pick out their own line, and a poor selection means a return and re-examination.

Preliminary Survey.—The line is selected by the instructor. The students do all the work of measuring both distances and angles and keep the notes in proper form.

There are three parties—transit, level, topography. Contours are taken by the topography party, using Locke level and metallic tape. Pacing, while really accurate enough for most purposes, establishes a low standard, and leads to work inferior to what is possible by this method if faithfully observed.

The map is made from field notes. The topography is given on sheets of double the scale of the map. There is, therefore, no copying.

Stump writing only is used, so that students may acquire this style of lettering.

Profile is made from notes entirely.

Contour Location.—(This refers to work on the lithographed topography just referred to.)—The time spent formerly in simple drawing of location is now used in making a contour location.

Each student has a separate problem. Points A and B are marked on lithographed sheet; a maximum is given, and the problem here requires use of the maximum grade throughout.

A line of no cut and no fill is marked in dotted line as a rough guide to alinement. The line is fitted, a profile made, and it is generally evident that changes can be made.

The line is adjusted and readjusted until correct position is found. To assist in this work calculations of quantities of earthwork are made. It is not at all uncommon for a second line to show more than a thousand yards improvement. To make the problem definite I limit them in degree of curve and in length of tangent. Later, I instruct them as to value of distance, curvature, etc.; but for this problem, the consideration of such matters would make it more complicated as a problem than I consider wise.

Most students make several changes from their first line before they are satisfied. The instructor is constantly passing from student to student, and criticising and suggesting.

It will be seen from the preceding that all the field practice in railway engineering is confined to the pleasant Saturdays of the spring and fall of one year (the school beginning in October and ending practically in May). The above limited program, therefore, really covers all there is time for. But this same school now devotes 18 weeks of each year wholly to vacations, and it is possible in that time now thrown away to do ten times as much without increasing the scholastic burden on the students in any way.

Going back a step further in the above quoted prospectus, to the account given of the work done and to be done in a few weeks' summer school, it will be seen at once that the time is totally inadequate actually to accomplish the results listed, except in the sense which we have before noted; that, namely, of giving the student some idea of how the work is done, but not to fit him to do it.

We close as we began, by saying that this defective training in the art of doing things is not so much to be regretted for the direct loss of bread-earning knowledge, but for the loss of all that training of the character which comes from working under or over other men. We also close as we began by saying that, in our belief, the defects which we have objected to have arisen chiefly, if not wholly, from the fact that the men who have controlled our engineering schools up to this time have very rarely been themselves engineers, but have derived all their knowledge and experience in education from methods developed only to train men for the three ancient "learned" professions, to which engineering as a profession bears but scanty analogy.

If so the evil will gradually correct itself. The concensus of opinion among engineers who learn from their own experience just what training a young engineer needs to succeed will in the end control the college courses. In the meantime we may rejoice and wonder that such good and useful training as is now available is to be had in such abundance to meet a demand which has, as it were, sprung up in a night.

LETTERS TO THE EDITOR.

THE IDEAL ENGINEERING SCHOOL.

Sir: I have read with pleasure and profit the series of articles in the Engineering News on the engineering schools, and am much interested in the articles now current, "The Ideal Engineering School," and feel that you are pointing in the right direction in the views expressed so far.

However, I hope to show you that you are in error in your implication when you ask (see Vol. XXIX., p. 419), "Where is the engineering school which turns out graduates who are experts in pacing distances," etc., and where further on you say, after speaking of the need of drilling students in the practical side of their profession, "Nothing of the kind is done in any engineering school known to us."

I can speak only for our own institution, but if you will kindly examine the map sent you this day, and what is below, I think you will be convinced that at least one of the engineering schools is endeavoring to make its graduates proficient virtually in the very direction you have indicated.

I was called here directly from six years of steady work in the field, at the beginning of the session of 1891-'92. I had no predecessor, and so no set rules to follow. Having graduated myself under a teacher who only once in my entire college course accompanied his class in the field, and then remaining only a few minutes, and having felt the very great need of something more than book knowledge to start with, I resolved that the students that should graduate under me should know or understand the details of fieldwork.

Six cadets ready to enter the junior class chose the new engineering course, and two postgraduates returned for what they might learn in engineering.

So soon as they could read off angles and set up the instruments, they were organized into a regular party, the two graduates being instrumentmen and the others chainmen, rodmen, etc., though after a time we found it best to alternate the students in their positions. One and a half hours four days in the week were allotted to this work, but the students soon grew so interested in it that they frequently worked the whole of Saturday morning.

Very little theoretical work was passed over that was not illustrated in some way on the ground. The university grounds being large and ample, and overlooking the Mississippi, all principles in triangulation could be, and were, most interestingly exemplified on the college campus. The students were thoroughly drilled in measuring angles by chain and rod, and then checking them by best instruments obtainable, and in determining error in result from error in observation. They were much practiced in plotting to scale from measurements taken on the ground, and not from models, great accuracy being insisted on rather than extra finish of the work. They were taught how to level directly in the field, and not from the book at all. The same was also true of contouring. They were very much interested in indirect leveling; church steeples and the stand-pipe in the city south of us and points in the gable end of buildings in Port Allen, across the river to the west of us, affording excellent targets, and all in good view from almost every part of the grounds. They took transverse section of the bayou to the north of the grounds and made profiles to large and small scales. When they came to the subject of curve work, after practicing all together long enough to become familiar with the subject each student was given a different example about like the one below, which is copied verbatim from an example set this class at their intermediate examination. The student was required to work out notes and make plot himself; and on the afternoon his curve was to be put on the ground, he was made transitman in charge, the teacher often finding he could be of more assistance at the front end of the chain than elsewhere:

A pair of tangents on a railway survey intersect at station 726+63; I = 42° 00′ Find P. C., P. T. and length of curve. Give curve notes for each full and half station to connect the tangents, by an 8° circular curve by the method of deflections of angles from the tangent. Plot same on a scale of ½ in. to 100 ft. If the curve is to the right and the first tangent bears N. 7° 30′ W., what is the bearing of the second tangent? What is the bearing of a tangent to the curve at station 727 on the curve?

The class made a survey for a road crossing the bayou to the north, which I will not stop to describe, but toward the latter part of March they were set to work on an undertaking which they barely finished before the close of the session, the map of which work, made by one of the junior members of the class, I send you. This was to make a complete map of the university grounds of more than 50 acres, showing thereon all buildings, trees, fences, ditches, etc., in their proper dimensions and positions. The map also shows the result of a survey for a tramroad descending from the level of the grounds on a 1% grade to the bayou flats.

Now I am fully sensible of the errors with which this map is chargeable, that the contours are not put on after the most approved methods, the plotted con-

tours do not agree as they should with the profile, the grade line should be plotted between the contours (as indeed it was on the pencil maps), the topography is often at fault, etc., but it is genuine, first-year, schoolboy work, and very fairly represents our grounds. The map has been exposed on the drawing table all during this session and has been used to check up measurements made by a much larger class. This accounts for its ill condition.

On the survey for the tramroad each student was required to keep a set of notes in full. In running the preliminary the grade line was run down in regular mountain descent style, the ground accurately contoured, and the students ran the levels over and over again until they could go over the entire length of the line and back from end to starting point across the grounds with an error on the tie-up of not exceeding half a tenth of a foot, using an ordinary English self-reading rod.

Each man made pencil plots and projected his own location, though only one location was run out (the one shown).

Stakes were cut and marked and put in place. The work was accurately plotted, and profile made, grade laid, and cut and fill calculated. The line was then accurately cross-sectioned, using different slope and roadbed for the cuts and fills, check-leveling from height of instrument as the work progressed. Finally, the quantities were all calculated, applying prismoidal corrections on such sections as required it, and an estimate written out in full of the cost of constructing. The full set of notes made something more than 30 pages in a large sized notebook.

Now it may be objected that if these students did all this work they had little time for intellectual development. The two graduates, who did little other work outside of their engineering except a small amount of English and about two hours teaching in the morning hours, finished Davies "Surveying," Henck's "Field Book, Wellington's "Economic Theory," Peck's "Mechanics" and Cotterill and Slade's "Lessons in Applied Mechanics," all of which they worked upon enthusiastically, in this one session. They both have secured good positions, one with the government engineers, and are little concerned now whether they improved intellectually or not.

The junior members of this class finished in the session Davies "Surveying" and Henck. They had to keep up a regular college course. The Professor of Mathematics, who is also President, said in a general faculty meeting, about the middle of the session, that there was better marked development in this very student who made the inclosed map than in any other in his department.

If the attraction of students is any criterion of the success of these methods, the palm must be awarded them, for not only have several students sought the school specially on account of the thorough fieldwork feature, but at this time there are precisely 4-7 of the students in three upper classes of the school in the engineering course, leaving 3-7 divided between the three other courses, literary, agricultural and general; while the number of teachers teaching specially in some one of the three other courses compare with the number of teachers teaching specially in the engineering course in the ratio of four to one.

Yours truly,

W. D. Taylor.

Professor Physics and Engineering; Louisiana State University and Agricultural and Mechanical College.

Baton Rouge, La., May 12, 1893.

(We have postponed the publication of this letter until it could appear in connection with an editorial discussion of this question, which now appears with it, and which is the best commentary upon it. While the methods mentioned in this letter are in general highly to be commended, in some minor respects they seem improvable.)

THE IDEAL ENGINEERING SCHOOL.

Sir: I have just finished a second reading of the fifth paper on "The Ideal Engineering School" in the June 8 number of "Engineering News," and desire to give the hearty approval of an old engineer to the views contained therein. In my opinion this paper (I have not read the previous ones) goes straight to the mark, and if it is desired to establish and operate engineering schools in place of merely scientific schools, it will be necessary to conduct them upon the lines laid down in this paper. Very faithfully yours,

E. Sherman Gould,

Cons. Engr. for Runkle, Smith & Co.

Havana, Cuba, June 15, 1893.

Sir: I have read with much pleasure your interesting and timely articles on "The Ideal Engineering School." You outline a plan which I have often had in my mind in an indefinite and unformed shape. You clearly and logically argue out a line of reasoning which seems to me incontrovertible. Until some such plan as you suggest is carried out, we never will have even good courses in engineering colleges, much less the ideal one. The engineering profession owes you a debt of gratitude for your articles. Sincerely,

Herbert M. Wilson,

U. S. Geological Survey, Geographical Branch.

Washington, D. C., June 18, 1893.

FIGURING TURNOUT CURVES.

Sir: Would you kindly state which is generally accepted as the better practice in a split switch turnout: 1. To figure the curve as starting at the point of switch rail, i. e., the thin end of the rail, and then shorten the lead just enough to allow for the thickness of the rail at the point; or

2, to figure the curve as starting at the heel (or thick end) of the switch rail, thus making it tangent to the switch rails?

The first method allows of the simplest formulas. Of six men in one office, three considered the first the better—three preferred the second. The writer saw (recently) about 20 turnouts in elevated railway yards put in that were figured by the first method. The frog numbers were from 4 to 6. If you will find room for an answer in your valuable journal you will greatly oblige, Six Readers.

(It does not make a cent's worth of difference which is done. The rationale of switch leads will be better understood if it be remembered that (1) there is no advantage other than convenience in using a circular instead of any other reasonably uniform curve, as, for instance, a parabola, which would naturally give a sensibly different lead; and (2) there is no reason why a compound instead of simple curve may be used; or, if the curve used be a parabola, why the curve should not be laid out with unequal instead of equal tangents, with the effect of giving a leeway of 10 to 15 ft. or more in the length of the tangent, while still obtaining a perfectly symmetrical and suitable curve. On so short a curve as a turnout, the difference between a parabola and circular arc is so small as to be quite undiscoverable by the eye. In general, we believe it to be somewhat better (i. e., more logical and accurate). Consider the point rail as a sub-tangent to the curve, the main rail being another sub-tangent, in which case the frog should be located to give a curve tangent to the heel of the point rail; but with almost as much propriety we may consider the point rail as a sub-chord to the curve, or split the difference between the two. The practical question of rail-lengths should really decide under these conditions if every trackman could be relied on to use judgment; but he cannot. Hence, the need for hard and fast sides.—Ed.)

THE BEST ROUTE FOR AN INTEROCEANIC SHIP CANAL.

Sir: I see in your issue of June 22 that the San Blas route for the Interoceanic Canal is revived. Will you permit me to call your attention to one point with regard to it; that is, the capacity of such a canal as that proposed as to the size of ships that could go through it? I presume the public in investing in any canal would have to be convinced that fairly large if not the largest ships afloat could go through it at something like a reasonable speed. What then would be the limit in size of ships that could by any power be driven or hauled through such a cylinder seven miles long with anything like reasonable speed? Could a ship, say, of 50-ft. beam, drawing 25 ft. of water (thus displacing quite half the actual water cross-section of the canal as given, viz., 75 ft. at water line, 70 ft. on bottom and say 30 ft. deep), be driven through the proposed tunnel, presuming that there were no current in either direction? Would not the enormous displacement in proportion to the size of the canal so raise the level of the confined water in front of the ship in its effort to get past the sides as to almost entirely prevent her progress? And if this would be the case, to a certain extent, even with 50-ft. beam, would it not be worse with the still larger and deeper ships built or building? Seven miles of such a piston and cylinder as this tunnel would be, I think, one very serious obstacle to the San Blas route. The dimensions must be very much increased and the estimate proportionately so.

Now it is obvious that these remarks apply equally to the two cuts proposed on the Nicaragua Canal, 8 miles on the Western Division and 2½ miles on what has been called the Great Divide. The proposed dimensions as published, with vertical sides and curves in the alinement, together with the existence of a current, however slight, in one direction or the other, for the excess of water to fall over the weirs, seem to me to call for increased figures also, if the present accepted location is adhered to.

I am one of those who, believing absolutely in the superiority of the Nicaragua route over any other, do not believe that the last word has yet been said as to the best possible location on that route for more reasons than the above; and I am convinced that important modifications will have to be introduced when the time comes.

But the San Blas route on any such figures as those given, or in comparison with Nicaragua on any terms, cost and capacity, etc., is, in my humble opinion, out of the question. There is admitted to be at Nicaragua room enough for the dozen or more practical locations which have been proposed from time to time, and if it does seem rather bold to suggest that after the elaborate work that has been done there, there may be still a possible improvement and a little more careful study. Yet this would be all in the line of reducing cost, as no one has ever doubted that the Nicaragua Canal can be built on the accepted location. All other routes possess elements out of the ordinary, and to some extent problematical. Let us stick to the Nicaragua by all means.

Yours faithfully, J. T. Ford,

Assoc. M. Inst. C. E.

Chicago, June 26, 1893.

CENTRAL PERUVIAN RAILWAY.

Sir: The number of switchbacks on this road is seven, and not 73, as you make it in printing my letter of June 15. The track reached Oroya on Jan. 10.

Yours truly, Jas. R. Maxwell.

Media, Pa., June 28, 1893.

IRON AND STEEL PLATE CHIMNEYS.

By Fred. W. Gordon, M. Am. Soc. M. E.

During the last 25 years the writer, as managing partner of different firms, has embraced among other lines of business that of constructing iron or steel plate chimneys, and during all of that time has never known any of them to fail in any particular whatever, and, moreover, contrary to what would be ordinarily supposed, constant painting has not been required. In fact, it is doubtful if these chimneys have received a coat of paint once in five years on the average. As many engineers may think that iron or steel plate chimneys are mere tin affairs, requiring guys, and are only to be thought of in connection with an indifferent plant, I would state that some of the largest chimneys to be found anywhere have been constructed of iron or steel.

It is surprising that a chimney constructed of so many pieces of burnt clay, laid together in a mortar that of itself has no tenacity whatever (the mortar of a brick chimney which has been heated and cooled a few times), should be preferred by thinking engineers to a casing of steel having a tensile strength of 60,000 lbs. per sq. in., securely riveted together and then solidly bolted through and through to the bottom of the foundation, and so stable indeed, that if pulled upon from the top it would upset from the very bottom of the foundation before it would noticeably bend through the length of the long shaft. The ordinary brick stack has to be considered as having a possible failing point at every joint, and calculated in its successive steps of thicker and thicker walls to determine the point of least stability. As a sample of these calculations Rankine's Applied Mechanics, pp. 240-243 may be referred to. Turning to the appendix therein, his calculations upon the stability of a 455½-ft. stack situated in Glasgow, Scotland, will be found as follows:

Dimensions and Stability of the Outer Shell of the Great Chimney of St. Rollox.

Divisions of chimney.	Height above ground.	External diameters.	Thicknesses.	Greatest pressure of wind consist't with security.
	Feet.	Ft. In.	Ft. In.	Lbs. per sq. ft.
V.	435½	12 6	1 2	77
IV.	350½	16 9	1 6	55*
III.	210½	24 0	1 10½	57
II.	114½	30 6	2 3	63
I.	54½	35 0	2 7¼	71
	0	40 0	....	

Total height from base of foundation to top of chimney 455½ ft.

*Joint of least stability.

This shows a different factor of stability at each section, and that as a whole the chimney may be considered as having a strength equal to the least of these. It will be noticed that the least factor is 55, which, according to Mr. Rankine, is just

4 lbs. above the highest noted wind pressure in the west of England.

A steel plate chimney substituted for this one at Glasgow would cost very much less money and would require less weight; the former because it requires less material, and the latter because it presents much less surface to the action of the wind. Moreover, the base would be spread toward the bottom, thereby securing extra stability. This will be exemplified by comparing the stability of a cylinder of light wood having a piece of sheet lead tacked on the bottom, of about twice the diameter of the wood, with that of another piece of wood of the same diameter as the lead, but of a heavier material, and weighing the same as the former piece of lead and wood together. It will be found that the small cylinder with the piece of lead is infinitely more stable than the heavier piece of wood having the same base.

In its practice throughout the United States the Philadelphia Engineering Co., of which firm the writer is a member, has assumed that 50 lbs. wind pressure per sq. ft. would be the highest really worth considering. No record has reached the writer showing so high a pressure of wind, and it will be observed from the following calculations that if it does, it will have to exceed anything yet heard of, and sweep every building in the line of the hurricane before one of these chimneys would be in the least affected.

As to the efficiency of the draft, it may be stated that the members of the American Society of Mechanical Engineers, in several recent debates upon chimney draft and chimney construction, have expressed themselves confident that an iron casing is superior to a brick one, in that it does not leak and draw in cold air, and thus impair its draft. Also when it is considered that an ordinary chimney will discharge under a full headway 130,000 lbs. of gas per hour, it will be readily conceived that the ascending column of heated gas can sustain but very small loss by radiation through the shell, even though the shell is entirely unlined.

The Philadelphia Engineering Co.'s practice covers the full-lined, half-lined and unlined shells. For ordinary boiler purposes the latter is quite satisfactory. Even though the wasteful temperature of 600° Fahr. is assumed for the escaping gas, and the temperature of the atmosphere outside is assumed at 100°, the average of 350° would be about the temperature of the shell of the chimney, and this would be only that of steam at 135 lbs. absolute, which no one would assume to be injurious to the shell of a boiler. As to the strength of these structures, during an exhaustive number of tests made by Sir William Fairbairn (which experiments are now often referred to as the basis of calculations upon iron and steel structures), four carefully executed experiments were made to determine the strength of thin, hollow tubes. In the following table will be found the dimensions of their several elements with their breaking strains. These tubes were placed upon hollow blocks and the weights suspended at the center from the block carefully fitted to the inside:

	Clear span, ft.	Thickness iron, in.	Outside diam., ins.	Sectional area, sq. ins.	Breaking wt., lbs.	Breaking weight by Clark's formula. Constant 1.2, lbs.
I.	17	.037	12.	1.3901	2,704	2,627
II.	15.7½	.113	12.4	4.3669	11,440	9,184
III.	23.5	.0631	17.68	3.487	6,400	7,302
IV.	23.5	.119	18.18	6.74	14,240	13,910

Mr. Edwin Clarke has formulated a rule from experiments conducted by him during his investigations into the use of iron and steel for hollow tube bridges, which is as follows:

$$\text{Center breaking load in tons} = \frac{\text{Area of material in inches.} \times \text{Mean depth in inches.} \times \text{Constant.}}{\text{Clear span in feet.}}$$

When the constant used is 1.2, the calculation for the tubes experimented upon by Mr. Fairbairn are given in the last column of the above table.

D. K. Clark's "Rules, Tables and Data for Mechanical Engineers," page 513, gives the following rule for hollow tubes:

$$W = \frac{3.14\ D^2TS}{L}.$$

W = Breaking weight in pounds in center.
D = Extreme diameter in inches.
T = Thickness in inches.
L = Length between supports in inches.
S = Ultimate tensile strength in pounds per square inch.

Taking S the strength of a square inch of a riveted joint at 35,000 lbs., this rule figures as follows for the different examples experimented upon by Mr. Fairbairn:

I. $3.14 \times 144 \times 0.037 \times 35{,}000 \div 204 = 2{,}870$
II. $3.14 \times 153.76 \times 0.113 \times 35{,}000 \div 187.5 = 10{,}190$
III. $3.14 \times 312.5 \times 0.0631 \times 35{,}000 \div 282 = 7{,}700$
IV. $3.14 \times 330.5 \times 0.119 \times 35{,}000 \div 282 = 15{,}320$

A close approximation between the breaking weights obtained by his experiments and those derived from Mr. Edwin Clarke's and Mr. D. K. Clark's rules will be observed. It may be assumed, therefore, that this system of calculation is practically correct, and that it is eminently safe when a large factor of safety is provided, and from the fact that a chimney may be standing for many years without receiving anything like the strain taken as the basis of the calculation—50 lbs. per sq. ft. Wind pressure at 50 lbs. per sq. in. may be assumed to be traveling in a horizontal direction and be of the same velocity at all points between the top and the bottom of the stack. This is the extreme assumption. If, however, the chimney is round, its effective area will be only half of its diametral plane. In its practice the Philadelphia Engineering Co. assumes that the entire force may be concentrated in the center of the height of the section of the chimney under consideration. Taking the average diameter of a 125-ft. chimney as 90 ins., the effective surface in square feet upon which the force of the wind may act will therefore be 7½ times 125 ÷ 2, which multiplied by 50 gives a total wind force of 23,437 lbs. The resistance of the chimney to breaking across the top of the foundation would be 3.14×168. (that is, diameter of base), multiplied by $.25 \times 35{,}000 \div (750 \times 4) = 258{,}486$, or 10.6 times the entire force of the wind. We multiply the half height above the joint in inches 750 by 4 because the chimney is considered a fixed beam with a load suspended at one end. In calculating its strength three-quarters way up, we have a beam of the same character. It is a fixed beam at a line halfway up the chimney, where it is 90 ins. in diameter and .187 in. thick. Taking the diametral section above this line and the force as concentrated in the center of it, or halfway up from the point under consideration, its breaking strength is: $3.14 \times 90 \times 0.187 \times 35{,}000 \div (381 \times 4) = 109{,}220$, and the force of the wind to tear it apart through its cross-section $7\frac{1}{4} \times 62\frac{1}{2} \times 50 \div 2 = 11{,}352$, or less than one-tenth of the strength of the stack. It may be asked why these stacks are built so strong, or equal to ten times the heaviest load. It is that in introducing a relatively new thing, and presenting a light structure to supplant that of the massive brick chimneys, a certain degree of prejudice had to be overcome, and further, it is an unanswerable reply to the objection that these stacks will weaken in time by rusting and getting thin. It will be seen from the calculations that they may be impaired to the extent of three-quarters of their thickness and still far exceed in stability any brick structure ever reared.

In constructing the foundations for these stacks the rules applicable to brick stacks and all tall structures have been employed, assuming that the center of gravity had to be moved a certain distance with the force of the wind. In steel stacks, however, the center of gravity is very low, as the weight is so largely in the foundation. Then again the diameter of the base is very large, and is secured by powerful bolts passing through and through it.

THE NEW WATER-WORKS PUMPING STATION AT MARLBOROUGH, MASS.

By B. R. Felton, City Engineer.

Since 1883 the city of Marlborough, Mass., has been supplied with water from Lake Williams. This lake is located near the city and has an area of

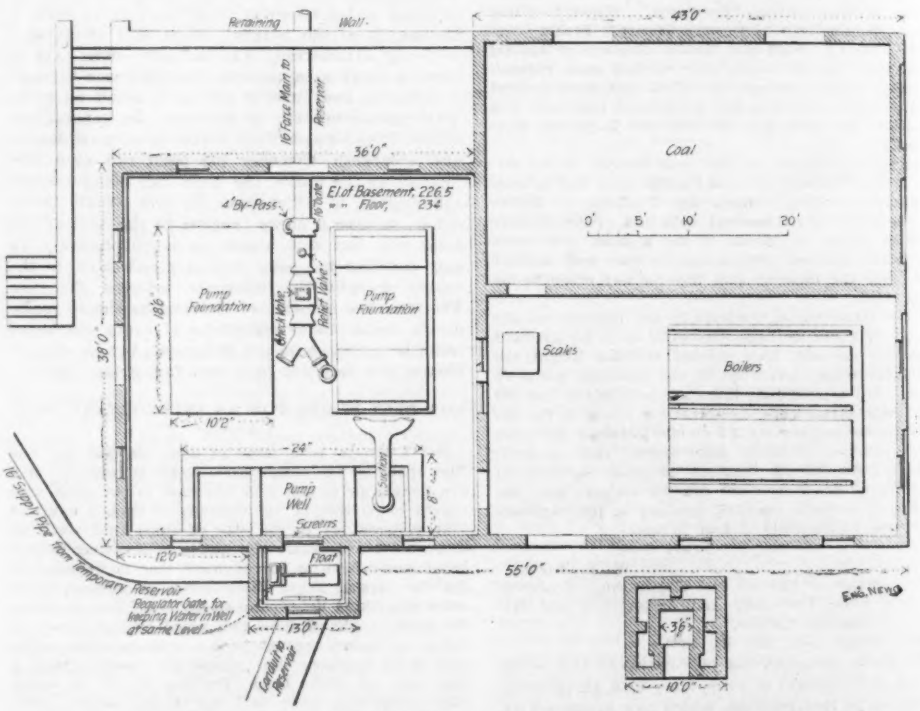


FIG. 1. PLAN OF NEW WATER WORKS PUMPING STATION; MARLBOROUGH, MASS.

72½ acres and a drainage area, including the lake, of only one-half square mile. This supply has been for several years inadequate, the pond being drawn lower and lower each succeeding year and not filling up in the spring.

Millham Brook was recently selected as an additional supply, it being proposed to build a dam 1,100 ft. long with a flow line 20 ft. above the meadow. The proposed reservoir would cover 71 acres and have a tributary watershed of 3½ square miles. A pumping station has been built on the north branch of Millham Brook, which has a drainage area of 2½ square miles, and a temporary dam forming a 500,000-gallon reservoir, built on that stream. For about four months in the year this brook will furnish water in excess of the consumption, while for six months there is not enough water to pay for pumping. During the four months of flow we propose to supply the city from this source, pumping the surplus into Lake Williams, which has storage capacity in excess of its drainage area.

The pumping station was designed with refer-

ence to the proposed basin, the floor being placed 4 ft. above proposed high water, and the basement 3½ ft. below high water. All parts of the pump that would be injured by water are above the high water line. A plan of the pumping station is shown by Fig. 1.

The pump takes water from a well located inside the pumping station, which will eventually be connected by a conduit with the large reservoir, but is now connected with the temporary reservoir by a 16-in. pipe. Water from the proposed conduit and reservoir will be admitted to the pump well through one of three 20-in. gates at different levels.

As the surface of the water in the temporary reservoir is 7½ ft. above the top of the pump well, it is necessary to regulate the flow of water into the well to conform to the speed of the pumps. This is accomplished by a special valve, shown by Fig. 2, which has a vertical movement at each opening of 2¼ ins. and is worked by a float and lever. This valve has worked very satisfactorily.

The check valve, relief valve and gates are located in the basement, as shown on the plan, Fig. 1.

The water is pumped through 2¼ miles of 16-in. pipe to pumping station No. 1, where a connection is made with the old 14-in. pipe which runs

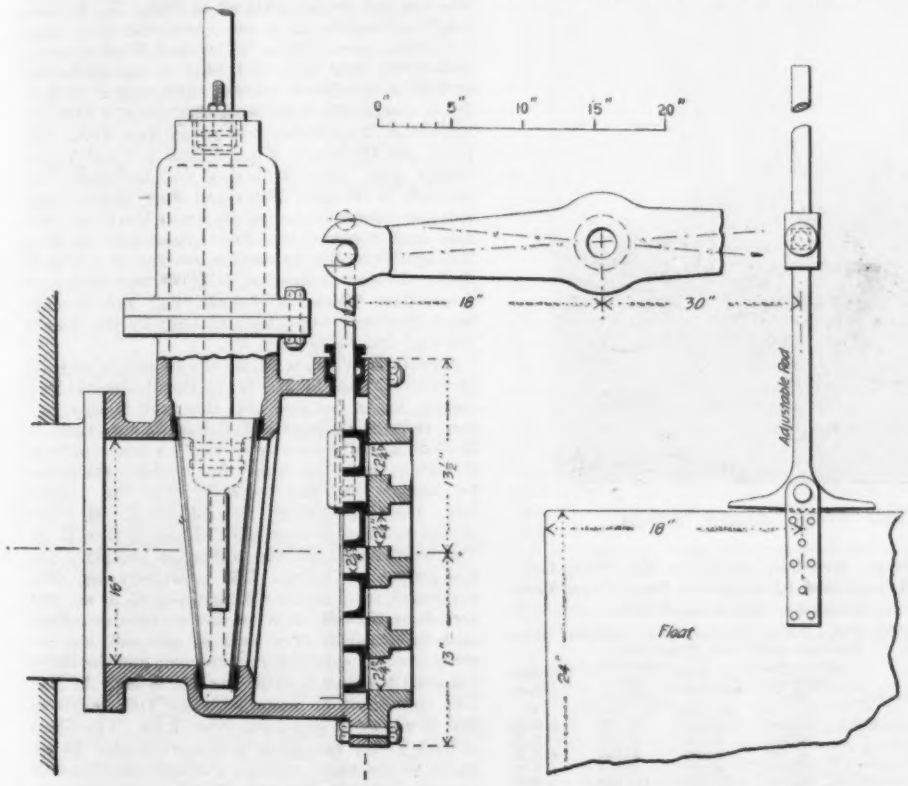


FIG. 2. DETAILS OF INFLOW REGULATOR VALVE; MARLBOROUGH, MASS.

to the reservoir about 1,800 ft. distant. The head pumped against when pumping into the reservoir is 408 ft. and when pumping into Lake Williams it is 258 ft.

The pumping engine used is a Worthington high duty, having 36-in. low pressure, 18-in. high pressure and 14-in. water cylinders. It has a rated capacity of 2,500,000 gallons per 24 hours, but will pump nearly 3,000,000 gallons. Steam is supplied from two 15-tube, 60-in. boilers furnished and set by the city. One of these boilers is sufficient to run the pumps.

The cost of the plant, including the force main, was $65,000.

SAFETY DEVICES APPLIED TO RAILWAY CARS.*

By Gen. Horace Porter, Vice-President, Pullman's Palace Car Co.

Ever since the introduction of railways in this country, speed, comfort and safety in travel have been the three salient merits advertised by passenger agents. Since the first trains were put on speed has quadrupled, comfort has become luxury, and safety, while it has not yet been able to avoid all sources of danger, has fully kept pace with the progress of other improvements.

America is one of the few countries which has departed entirely in the construction of its cars from the stage coach architecture, and has adopted a long car in one compartment containing a middle aisle which admits of communication throughout the train. In the early days of railways the car was frail in construction, and, at first, was mounted upon wheels without trucks, which constitute a source of danger when passing around curves, and in case of broken wheels and axles, even when trucks were introduced, they were so crude in construction that for some time but little advantage was derived from them. The brakes were clumsy and of little service; the couplings were dangerous; there were no buffers; "telescoping" in collisions was of frequent occurrence; the ends of the flat bar rails, cut diagonally, so that they would lap and form a smooth joint, often became "sprung," and the end of the rail with its sharp point would rise high enough for the wheel to run under it, rip it loose and send the pointed end through the car. This was called a "snake's head," and the unlucky passenger sitting over it was likely to be impaled against the roof. A stove was placed in each end of the car, which did little more than threaten passengers with conflagration, and generate noxious gases to poison the air. The dust was suffocating in dry weather, and there were no adequate spark arresters on the locomotive or screens at the windows of the cars. The candles or lamps used only served to make the darkness visible, and reading in such a light produced serious injury to the eyes. From that day until the present time the ingenuity and energy of inventors have been constantly taxed in perfecting devices for increasing safety, and every year has shown more or less progress in overcoming the dangers of travel.

In 1849 the Hodge handbrake was introduced, and in 1851 the Stevens brake. These earlier forms of car brake simply provided for a hand-brake at each end of the car, which was applied by direct pressure to the wheels of the truck nearest to it. In 1852 the Tanner brake was invented, which was a marked improvement upon the brakes previously used. It consisted of a series of rods and levers pivoted under the car and operated by a brake-wheel from the platform. All of the brakes could be set upon the wheels of both trucks simply by the turning of one brake-wheel at either end of the car. In 1869 George Westinghouse patented his airbrake, by which power from the engine was transmitted by compressed air carried through hose and acted upon the brakes of every car in the train. This marked an important era in the history of safety devices. In 1871 the vacuum brake was devised, by means of which the power was applied to the brakes by exhausting the air instead of by applying direct air pressure.

Another important improvement was the mounting of cars upon trucks of either four or six wheels.

Much difficulty was experienced for many years from the imperfect methods employed in coupling cars. The ordinary means consisted of coupling pins inserted into links attached to the ends of the cars. There was a great deal of "slack," the jerking of the train was in consequence very objectionable, and the distance between the platforms of the cars made the crossing from one car to another exceedingly dangerous. In case of collisions one platform was likely to rise above that of the next car and "telescoping" was of frequent occurrence. These difficulties were overcome by devices for more securely and conveniently coupling the cars. The Miller coupler and buffer was patented in 1863 and obviated many of the discomforts and dangers arising from the old methods of coupling. This was followed by the Janney coupler and other devices.

To avoid the danger from oil lamps experiments were made for the purpose of devising a compressible gas which could be carried in tanks and readily supplied to burners in the car, and gas lighting has now been very successfully applied.

The satisfactory heating of cars was not successfully accomplished until a method was devised of circulating hot water through pipes. So many accidents from the destruction of cars by fire occurred that the public became panic stricken, and popular sentiment was so aroused that appeals were made to the state legislatures to prohibit by law the former methods of heating. This has led to the heating of cars by steam taken from the engine and indirectly therefrom by hot water circulation.

The improved means of framing and strengthening cars, required by increasing speed, did not make decided progress until sleeping cars were introduced. The first type of car known as the "Pullman car" was completed in 1864, and the introduction in this car of what is known as the "Pullman upper berth," proved to be a very valuable device in protecting it against being crushed in case of becoming derailed and rolling down an embankment. Experience proved this car to be very many times stronger than ordinary passenger coaches in offering resistance to accidents arising from the causes mentioned. As the sleeping car had to carry greater weight than other cars the framing of the car had to be made stronger than ordinary passenger coaches, and it was found by experience that in collisions these cars were much less likely to be crushed. Particular attention was thus directed to strengthening the bodies of all cars. The "Pullman end safety device" is one of the latest inventions that have been introduced into the framing of passenger coaches for the purpose of conferring additional strength. It is attached to and forms part of the end frame of a car. The end sill is re-enforced by a broad horizontal plate of steel, to which is riveted a heavy steel angle extending across the whole width of the car. A similar angle is attached to the corners of the floor frame by steel knees and, extending upward in the line of the corner posts, is bent over and across the top beam forming a continuous steel frame around the whole end of the car, so that in case of collisions the colliding engine or car is prevented form crushing into the end and splitting the car open. In fact, the bending of the steel frame produced by a collision tends to draw the floor, sides and roof together rather than to force them apart.

One of the most serious dangers to which passengers and employes were exposed was in passing from one car to another while the train was in motion. The introduction of the improved couplers and buffers brought the platforms closer together and did something toward obviating the difficulty; but in rounding sharp curves at high rates of speed ,or during violent wind storms, there were many cases in which persons were thrown from the train. As early as 1852 devices were invented which provided for diaphragms of canvas to connect adjoining cars and form a partly protected passageway between them. These were first applied to cars on the Naugatuck Railroad in Connecticut in 1851, but were very crude and were abandoned after a trial of about four years.

At a later date when dining, smoking and library cars were added to the limited express trains there became an absolute necessity for the construction of some safe passageway between cars, as passengers were then obliged to pass from one part of the train to another. In 1886 George M. Pullman set to work to devise a practical system for constructing a continuous train,

*Condensed from a paper read before the Railway Commerce Congress at the World's Columbian Exposition.

and at the same time to provide for sufficient flexibility in the connecting passageways to allow for the motion consequent upon the rounding of curves. His efforts resulted in what is now known as the "Vestibuled Train." The invention was patented in 1887, and introduced a safety appliance more valuable than any yet devised for protection in case of collision.

While there have been a number of minor devices introduced from time to time which have contributed to the safety of cars only the most important ones, those which have brought about radical improvements, have been referred to.

JAMMERSBERG DRIFT BRIDGE; ORANGE FREE STATE.

The accompanying view represents the Jammersberg drift highway bridge over the Caledon River, Orange Free State, South Africa. The bridge was built for the government of that state to the designs of Mr. A. Klute, the engineer, by Mr. John Scrimgeour, contractor, of Port Elizabeth, Cape Colony, to whom we are indebted for photographs and particulars.

The bridge is 918 ft. long, with six steel bow-string spans of 153 ft. span. The height from low water to top of girders is 60 ft. The abutments and piers are built of hard blue sandstone of great density, found near the site, and are founded on solid rock. The stone weighs 146 lbs. per cu. ft., and is one of the few kinds found in the state which will resist both heat and water. The masonry is laid in cement mortar. The cubic contents of the masonry amount to about 3,000 yds., and the steel work weighs about 500 tons. The contract price was about $165,000. During the progress of the works some inconvenience was caused by floods, that in June, 1891, having been the highest since the year 1881, and washed away part of the plant and material belonging to the contractor.

The foundation stone was laid in January, 1891, and the masonry completed in February, 1892. The erection of the spans was commenced in July, the last span erected in October, and the bridge completed and opened early in December, 1892.

JAMMERSBERG DRIFT BRIDGE; ORANGE FREE STATE, SOUTH AFRICA.

USE OF THE PLANIMETER IN RAILWAY PRACTICE.

A correspondent from Wayne, Ill., sends us the following, and trusts that it may be of some benefit to his fellow-engineers: Various articles on the use of the polar planimeter have appeared in your journal from time to time, but they were in the nature of descriptions and mathematical demonstrations of its workings, together with various formulas, and not comparisons of actual results in every-day practice. Engineers are seldom met with in railway construction that have ever used the planimeter for the computations of their estimates, or know anything about its advantages for such work. In the calculation of areas of complicated cross-sections and overhaul for monthly estimates, where time is always a desideratum, it is to be highly recommended, and its accuracy is shown by the following comparison taken from actual practice on heavy railway construction in earth and rock, where the work was done by steam shovels, and numerous cuttings were necessary to finish each cut.

The cross-sections were broken up, as shown by Figs. 37 to 42, on page 519 of your journal for June 1, 1893, in the article by Mr. Hermann, on Steam Shovel Work. The cross-sections were plotted on the ordinary ruled 10 × 10 to 1 in. cross-section paper, which paper will be found to be incorrect as to exact scale, probably owing to the shrinkage of the paper in ruling; but with an instrument having a graduated arm a setting can be found by trial to give the correct answer.

For overhaul, "yard ordinates" were plotted on Plate "A," profile paper; vertical divisions representing stations on scale 1 in. to 400 ft., and horizontal rulings representing 500 cu. yds., or a scale of 1 in. to 10,000 cu. yds. The instrument used was made by Keuffel & Esser, and the arm was graduated its entire length to ½ mm. For detailed description, formulas, etc., see Mr. Wm. Cox's manual, published by Keuffel & Esser, New York. The comparison of results is given below:

Comparison of Results by Original Cross-sections. Final Estimate and Polar Planimeter.

Excavation.	By original cross-section. cu. yds.	By final estimate. cu. yds.	By Polar planimeter. cu. yds.	Difference. %
Dalrymple cut....	61,164	61,196	60,871	− 0.52
Heine "	52,801	52,801*	51,763	− 1.96
Herrick "	45,411	45,521	45,683	+ 0.35
Smith "	43,947	43,223	43,088	− 0.31
Baker "	116,647	113,510	114,502	+ 0.86

* A coincidence.

For overhaul in two cases, calculated by analytic and graphic methods: 1,419,187 cu. yds. hauled 100 ft., planimeter made + .021% difference; 1,627,839 cu. yards hauled 100 ft. planimeter made + .031% difference.

RAILWAY IMPROVEMENTS FOR THE WORLD'S COLUMBIAN EXPOSITION TRAFFIC.—V.

Chesapeake & Ohio Ry.—Mr. H. W. Fuller, General Passenger Agent, informs us that 20 vestibuled first-class day coaches were added to this road's equipment on June 1, being of the same pattern as the equipment on the "F. F. V. Limited." A solid vestibuled train has been added to the service, leaving Washington, D. C., daily at 2 p. m.; Norfolk and Old Point Comfort, Va., 11 a. m.; Richmond, Va., 2 p. m., and running through solid, arriving in Chicago, at the Exposition station (as this line uses the tracks of the Illinois Central R. R., in Chicago), at 4:55 p. m. This train is lighted by electricity and has dining cars from Washington. The C. & O. route to Chicago, from New York, is via the Pennsylvania R. R. to Washington; Chesapeake & Ohio Ry. from Washington to Cincinnati; and Cleveland, Cincinnati, Chicago & St. Louis Ry. from Cincinnati to Chicago, via Indianapolis. The "F. F. V. Limited" leaves New York 5 p. m., via Pennsylvania R. R., and Washington, 11:10 p. m. The Old Dominion steamers from New York connect at Old Point Comfort and Norfolk, Va. There are through sleepers on this train daily to Chicago. The round trip excursion rate from New York by this route is $32; from Washington, $26. The tickets are good for stop-over at Washington, the mountain resorts, White Sulphur, the hot and warm springs of Virginia, etc.

Mr. Geo. W. Stevens, General Manager, writes us in regard to the preparations made by this company for the handling of anticipated Exposition traffic, that ten passenger coaches have been added to the equipment, costing $64,000. No improvements have been made in track or terminals for this particular business. Trains Nos. 1 and 3 (westbound), and 2 and 4 (eastbound), are through trains, and make direct connection at Cincinnati with trains over the Cleveland, Cincinnati, Chicago & St. Louis Ry. (Eng. News, June 22) to and from Chicago. Train No. 1, leaving Washington and Richmond at 2 p. m., connecting at former point with Pennsylvania R. R. train from New York at 8 a. m., arrives at Chicago next day at 5:15 p. m. This train hauls a sleeper, two coaches and combination car, which run through to Chicago. No. 3, leaving New York at 5 p. m.; Washington, 11:10 p. m., and Richmond, 10 p. m., arrives at Chicago the second morning at 6:55. No. 2, leaving Cincinnati at 8 a. m., connecting with train from Chicago at 8:10 p. m., arrives Washington at 6:35 a. m., New York at 1:10 p. m. and Richmond at 6:25 a. m. No. 4, leaving Cincinnati at 6:15 p. m., connects with train from Chicago at 8:25 a. m., arrives at Washington 2:10 p. m., New York, 8:20 p. m., and Richmond, 2 p. m. Nos. 1, 3 and 4 have dining cars, and all trains via Richmond run through to Newport News and Fort Monroe with steamer connection across Hampton Roads for Norfolk and Portsmouth. The Chesapeake & Ohio Ry. exhibit at the Exposition consists of a consolidation freight locomotive, built by the Richmond Locomotive Works, Richmond, Va.: and a ventilated fruit and vegetable car, built by the American Car Co., Basic City, Va.

Norfolk & Western R. R.—From details of train service furnished by Mr. W. B. Bevill, General Passenger Agent, we find that this road is now running through Pullman buffet sleeping cars between Norfolk and Chicago, by way of its new line from Kenova to Columbus, O. From Columbus to Marion, O., the route is over the Columbus, Hocking Valley & Toledo R. R., and thence to Chicago over the Chicago & Erie R. R. The westbound train leaves Norfolk at 7:30 a. m., and arrives at Chicago 7:55 p. m. next day. The eastbound train leaves Chicago at 7:45 p. m., and arrives at Norfolk 10 a. m. the second day. Each train is composed of a baggage car, mail and express car, day cars and Pullman car, and the trains run solid between Norfolk and Columbus. At Norfolk connection is made with the Old Dominion line steamers to and from New York. The Shenandoah Valley rail route is also available. In addition to the above service, Pullman sleeping cars are run between Kenova, W. Va., and Chicago. The westbound train leaves at 3:50 p. m. and arrives at Chicago at 7:25 a. m., while the westbound train leaves Chicago at 7:45 p. m. and arrives at Kenova at 11:55 a. m.

Cincinnati, Hamilton & Dayton R. R.—Mr. C. G. Waldo, Assistant to the President, states, in regard to new equipment, etc., on account of the World's Columbian Exposition business, that during the last year this company has purchased 25 first-class coaches. 2 parlor cars, 2 baggage cars, 15 ten-wheel locomotives and 4 six-wheel-switching engines. In addition to the above it has also purchased and has nearly laid 40 miles of heavy section new steel rail, all of which represents a total cost in round numbers of $520,000, and the purchase of same was made necessary in order that the road might be in shape to handle the Exposition business.

THE RECORDING PYROMETER.*

By Prof. W. C. Roberts-Austen.

The merit of showing that thermo-junctions could be readily employed for measuring high temperatures clearly belongs to A. C. Becquerel (1826), and to his son Edmond (1835, 1863, et seq.). We owe to Barus

*Condensed from a paper read at the last meeting of the Iron and Steel Institute. See also descriptions of the Le Chatelier pyrometer in Eng. News, June 20 and Oct. 10, 1891.

gratitude for the very careful recent work, which has proved that the indications afforded by thermo-junctions are trustworthy at very high temperatures, and it is to the advocacy of H. Le Chatelier that the recent adoption of thermo-junctions is due. The latter physicist has, moreover, discovered an alloy of platinum and rhodium which possesses properties that render it singularly applicable for use with pure platinum as a thermo-junction.

The recording pyrometer described at the last meeting was devised by the author mainly in answer to a request made by Mr. E. P. Martin; and the first instrument made was naturally offered to him for use at the new Dowlais Works, at Cardiff.

Mr. Martin made preparations on a most liberal scale for the installation of the instrument; no less than 360 yds. of wires were laid down for connecting the furnaces with the galvanometer, and the thermo-couples were, in the first instance, introduced into the horse-shoe main of a blast furnace.

The anticipation that the "recorder" would prove to be a valuable adjunct of an iron and steel works was amply justified, as the curves obtained by its aid show. (Sample curves made by the instrument were submitted and explained in detail. The curves show just the variations in temperature as the several stoves are connected, and any uneven working can be at once detected and remedied.)

The importance of a constant temperature of the blast is manifest. The ratio that the reducing actions bear to the fusing ones varies with the temperature of the blast, and if a furnace has been steadily working at a given rate, it will be prejudicial to suddenly increase the activity of reduction in the cooler parts of the furnace, as they would then contribute reduced iron and pasty slag at a greater rate than that at which they could be disposed of in the zone of fusion. The effect of a rapid increase in the temperature of the blast influences the reducing zone more rapidly than it does the zone of fusion, hence the tendency of the furnace to choke if the temperature of the blast is suddenly augmented.

It appears to be recognized that an unduly high temperature of the blast is favorable to the formation of scaffolds, and the introduction of cold-blast is known to remove them.* Hence it is desirable not only to be able to measure the temperature of the blast, but to be able to observe the temperature at any given moment. In recent forms of the "recorder" a subsidiary mirror diverts the ray of light from the drum, and throws it on to a divided transparent scale on the top of the camera, so that a direct observation of the temperature can be made without seriously interrupting the progess of the photographic record. By watching the progress of the record it is frequently possible to diminish the amount of fuel charged into the furnace, and thus to effect economies which may, it is hoped, attain considerable proportions.

*"Stahl und Eisen," vol. xii. p. 114.

If in a given set of conditions 18 units of carbon are required to smelt a ton of iron with the temperature of blast at 880° Fahr., 16 units of carbon will still be required if the temperature be 1,660 Fahr., so that there is clearly a limit to the advantages of heating the blast. A large blast-furnace smelting iron may have a capacity of 35,000 cu. ft., and of this 20,000 cu. ft. is in brilliant ignition, and presents the largest mass of fuel in rapid combustion which is employed in any single industrial operation. In view of all the complex problems involved in the working of a blast-furnace, the solution of which depends mainly on thermal conditions, it is truly remarkable that hitherto there has been no sustained effort to accurately measure and record the temperature of the blast, this being the factor of paramount influence, and the one that can be most readily controlled.

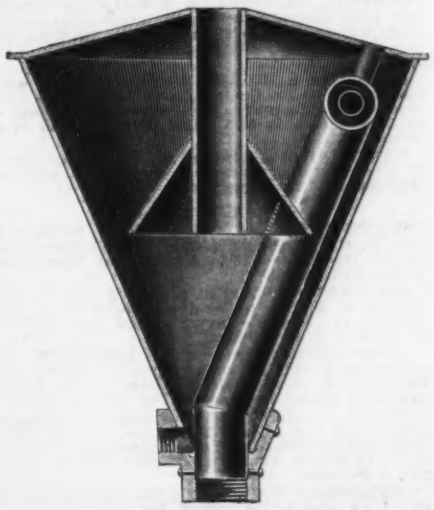
The chief advantages which may be claimed for the appliance are as follows:

(1) A check is placed on the gasmen, and, to a less extent, on the men at the furnace-top. (2) Inferences may be drawn as to the conditions which prevail in the interior of the furnace. (3) Accurate information may be gathered as to the time of the reversal of the valves, and of casual admission of cold blast. (4) Certain indications, afforded by the curves, show that changes have been effected in the accessories of the blast-furnace, such as the removal of tuyeres, alterations in breast-plates, etc., etc.

It should be observed that the appliance is popular with the work-people, who find that regularity in conducting the details of the various operations means increased output, and, moreover, the gasmen recognize that it is to their advantage to have an autographic record of the way they have done their work.

THE ECLIPSE EXHAUST PIPE HEAD.

We illustrate in the accompanying cut a condenser head for steam exhaust pipes, invented by Mr. Geo. W. Christoph, of Hartford, Conn., which seems to possess some good features in simplicity and cheapness of construction. This device was patented in March, 1893, the number of the patent being 493,908, and is intended to secure a rapid and practically complete separation of the grease and entrained water from the steam without insuring perfect condensation. As will be seen the head consists of a metal shell shaped like the inverted frustum of a cone having a cover penetrated by a vertical pipe carrying a conical deflector. The exhaust steam is conducted to the interior of the head through an extension of the exhaust pipe provided with an elbow arranged to discharge the steam horizontally against the walls. To assist in condensing the steam an induced current of air is secured by a small pipe entering the elbow of the steam pipe, as clearly shown in the drawing. The



The Eclipse Exhaust Pipe Head.

purpose of the deflector is to aid the elbow in imparting an incipient gyratory or rotary motion to the steam causing it to impinge against the cool walls of the head. The head is preferably placed in a vertical position. It has an outlet for the dry steam at the top and a connection for a drip pipe at the bottom. The following are the claims of the inventor as given in his letters patent:

1. A condenser head having a conductor for the exhaust steam opening interiorly of the head and near its peripheral wall and an air inlet in said wall at or near the discharge for the exhaust steam, substantially as described.

2. A condenser head having a conductor pipe communicating with the exhaust steam passage and an elbow at its top to deliver exhaust steam at or near the peripheral wall of the head and in a plane at right angles to the axis thereof and an air inlet through the wall of the head near the discharge end of said conductor pipe, substantially as described.

3. In a condenser head, the combination with a conductor pipe communicating with the discharge from the exhaust pipe and extending upwardly within the head and having an elbow at its top and an air inlet pipe communicating with the atmosphere through the wall of the casing and projecting through said elbow in the direction of the opening thereof, substantially as described.

4. A condenser for exhaust steam pipes comprising in combination a conical shell, a dished cover plate having an escape aperture, a depending flaring deflector surrounding said aperture, a conductor pipe communicating with the discharge from the exhaust steam pipe and having its discharge above the lower edge of said deflector and near the peripheral wall of the shell and air inlet pipe communicating with the atmosphere and projected past the end of the conductor pipe, substantially as described.

The head is manufactured in standard sizes for from 1-in. to 18-in. exhaust pipes, by the New York Exhaust & Blow Pipe Co., Hartford, Conn., with New York city offices at 136 Liberty St.

WORLD'S COLUMBIAN EXPOSITION.—XVI.

General Committee of Engineering Societies.

A card issued by Mr. Max Schmidt, Secretary of this general committee, states that informal gatherings will be held in the rooms of the Associated Engineering Societies, 10 Van Buren St., every Monday evening from 8 to 10. Members and their friends are invited to be present to meet foreign and visiting engineers. The Chicago engineers are specially requested to call at the rooms when in the vicinity, if only for a minute, in order to inspect the register on file, so as to ascertain which of their friends are in the city, and to assist in entertaining them and foreign engineers.

Attendance.

The table of attendance for May, comparing the figures of Philadelphia, 1876, with those of Chicago, 1893, was given in our issue of June 20, and we now give the table for June, as issued by the Bureau of Admissions. The total attendance during May was 427,659 at Philadelphia, in 1876 (commencing May 10); 2,610,813 at Paris, in 1889; and 1,516,369 at Chicago, in 1893. The figures for Chicago for June are as follows:

Chicago, 1893.			Philadelphia, 1876.	
June 1		61,727	June 1	35,804
June 2		74,272	June 2	30,741
June 3		82,069	June 3	38,090
June 4		74,513	June 4, Sunday	
June 5		84,034	June 5	38,625
June 6		106,868	June 6	30,741
June 7		93,711	June 7	49,291
June 8		169,016	June 8	37,305
June 9		88,148	June 9	32,789
June 10		102,173	June 10	30,560
June 11		93,368	June 11, Sunday	
June 12		106,750	June 12	38,091
June 13		128,830	June 13	36,164
June 14		115,356	June 14	37,829
June 15		200,706	June 15	60,099
June 16		117,301	June 16	56,494
June 17		184,767	June 17	56,454
June 18		81,920	June 18, Sunday	
June 19		116,624	June 19	57,610
June 20—			June 20—	
Paid	94,377		Paid	33,747
Free	35,580		Free	11,053
		129,957		44,800
June 21—			June 21—	
Paid	98,053		Paid	23,207
Free	34,315		Free	10,817
		132,368		34,024
June 22—			June 22—	
Paid	132,265		Paid	19,133
Free	36,966		Free	10,526
		169,231		29,659
June 23—			June 23—	
Paid	102,551		Paid	20,645
Free	33,651		Free	10,513
		136,202		31,158
June 24—			June 24—	
Paid	133,878		Paid	20,575
Free	33,761		Free	10,311
		169,639		30,886
June 25—			June 25—	
Paid	63,749		Paid	18,332
Free	24,516		Free	10,066
		88,265		28,184
June 26—			June 26—	
Paid	94,344		Paid	18,333
Free	34,847		Free	10,254
		129,191		28,587
June 27—			June 27—	
Paid	131,132		Paid	16,157
Free	18,146		Free	10,027
		149,278		26,184
June 28—			June 28—	
Paid	98,897		Paid	18,270
Free	35,801		Free	10,367
		134,698		28,637
June 29—			June 29—	
Paid	110,882		Paid	19,184
Free	36,316		Free	10,111
		147,198		29,295
June 30—			June 30—	
Paid	75,947		Paid	18,729
Free	33,870		Free	10,019
		109,817		28,748

A FORMULA FOR MAGNETIC DECLINATION AT ALBANY, N. Y., BETWEEN 1686 AND 1900.

The following interesting discussion regarding magnetic declination at Albany, N. Y., and a formula for computing the same for any date between 1686 and 1900 is taken from the last annual report of Mr. Horace Andrews, City Engineer of Albany:

The Dongan charter, of 1686, describes the north and south boundary lines of the city as northwest in course. About the year 1764 the interpretation of this course seems to have been in dispute, and maps on parchment in this office give the position of a true northwest line as compared with that given by the magnetic needle in 1686 and 1764.

The boundary lines, as finally fixed, seem to have been taken as northwest lines according to the pointing of the needle in 1764, the services of Simeon DeWitt, for 50 years the Surveyor General of the state, having been engaged for the correct performance of the work. The fixing of these boundaries seems to have affected the lay out of the larger part of the city; the principal avenues, Madison, Clinton, etc., apparently having a bearing northwest, approximately, as the needle pointed in 1764, or, N. 51° 40′ W. true, the cross streets being about at right angles to the northwest streets. It is customary to refer to the northwest streets as running east and west, and those crossing them at right angles as running north and south.

In the valuable discussions of the United States Coast and Geodetic Survey, as to the declination of the magnetic needle, no determinations at Albany previous to 1817 had been available. Upon the discovery of the information contained in the maps above referred to it was sent to the Coast and Geodetic Survey office in Washington, where its receipt was very cordially acknowledged; the Chief of the Computing Division, Mr. Charles A. Schott, using the data sent him in connection with the observations of his

office, made at the Dudley observatory as late as 1890, to derive a formula expressing very nearly the value of the declination at any date between 1686 and the end of this century. The formula representing the secular oscillation of the needle is:

$$D = +8.34° + 2.80° \sin.(1.38° m. - 14.8°).$$

where m is the date minus 1850, and D is the declination in degrees and decimals. The sign + denotes a west declination. The minimum value occurred about 1795, and then amounted to 5° 32'. On Jan. 1, 1893, it will be (was) 10° 18'. The time of maximum west variation, as indicated by the formula, will be about the year 1926. At the close of this century the needle will point about as it did at the time of the Dongan Charter.

The Coast Survey has at various times published formulas for magnetic declination at various points for a large number of its more important stations.

STATUS OF THE CORINTH SHIP CANAL.

The work of piercing the Isthmus of Corinth nears the end at last. This canal, 20,631 ft. long, has been excavated through a formation of blue mari, tufa and conglomerates, and the ground was cut by numerous faults, particularly in the upper strata. The plans originally called for an almost vertical cut in this material, with a maximum depth of cut of 285 ft. measured from the bed of the canal. As might have been foretold, the sides commenced to slip, though the climate of Greece is exceptionally dry, and it was then deemed necessary to give them a slope of one horizontally to five vertically, necessitating the removal of a large amount of additional material. But the funds were exhausted and much time elapsed before a new company could be organized and more capital raised. It should be mentioned also that between the layers of tufa in many places sand strata occurred which would take a natural slope of 1 in 7 to 1 in 10. All this sand surface has been protected by masonry laid in cement.

Up to February of this year the extra excavation was all completed, excepting a small portion at each end of the canal, and the north and south walls were also almost entirely finished up to the two entrances.

The total amount excavated from the canal to the date given was 11,183, 677 cu. m., of which 8,220,505 cu. m. were dug out under the original company. There remained yet to be removed 293,-728 cu. m. On the Corinth side the canal has been dredged out to full depth of 26.24 ft. for 3936 ft. from the point of beginning; while a cut of 1.64 ft. is to be taken up over a length of 2,525 ft. On the Kalamaka side the full depth is secured for a length of 2,886 ft. The profile shows a dike of original material left in place near each end of the canal to keep out the seawater. Of the masonry yet to be finished there remained, in February, 230 m. in length of the north wall and 650 m. of the south wall, or about 12,000 cu. m. in all. It is proposed to remove about 150,000 cu m. in the dry and about 15,000 cu. m. by dredging under the present conditions; the water will then be let into the canal and the dredges will complete the work.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

BAIE DES CHALEURS.—This road is now in operation from Metapedia, Que., to the Cascapedia river, 60 miles, and is nearly completed to the Caplin river, 20 miles. It is hoped to have the entire distance to Paspebiac, 100 miles, completed this fall.

ELKHART & WESTERN.—Work on this road between Elkhart and Mishawaka, Ind., 11 miles is progressing rapidly. Three or more miles of track have been laid from Mishawaka, and work is being pushed over the entire line. Bick & Glouse, Toledo, O., are the contractors.

PITTSBURG, MARION & CHICAGO.—According to press reports, this road will be extended in Ohio through New Waterford, North Lima and Poland to Youngstown, a distance of 22 miles. Surveys are now being made and the construction will soon be commenced. Gen. Man., C. H. Smith, New Lisbon, O.

PITTSBURG, VIRGINIA & CHARLESTON.—The right of way is being secured for an extension of this road from Brownsville, Pa., to the mouth of Ten Mile creek, and it is reported that the grading contracts will soon be awarded. Pres., J. M. Du Barry, Philadelphia.

Projects and Surveys.

DEER CREEK.—Incorporated in Maryland to build a railway from Belaire, Md., to the Susquehanna river, near Havre de Grace; capital stock, $300,000; N. S. Mitchell, Edward Farney, F. Z. Gorrell, O. M. Whittaker,

INDIANAPOLIS, LOGANSPORT & CHICAGO.—The right of way has been secured for this road. Pres., E. N. Talbott, Logansport, Ind.; Treas., E. G. Cornelius, Indianapolis; Ch. Engr., W. A. Osner, Logansport.

Southern.—Existing Roads.

CHARLESTON, CLENDENNIN & SUTTON.—The stockholders of this road met at Charleston, W. Va., June 27, and authorized an issue of bonds for $100,000 to liquidate its outstanding debts and purchase rolling stock. Bonds will soon be issued to extend the line up the Elk river.

FLORIDA CENTRAL & PENINSULAR.—Tracklaying on the Savannah extension of this road has progressed from the southern terminus to beyond the Georgia state line, and the track is now being laid from Savannah, Ga., southward. It is expected that the road will be completed next month.

FLORIDA, PENINSULAR & GULF.—A branch of this road, formerly the Arcadia, Gulf Coast & Lakeland, will soon be constructed in Florida from Manatee to Plant City. Engr., Col. G. Morton, Tampa, Fla.

KANAWHA & MICHIGAN.—Through trains will begin running on the Gauley river branch of this road as soon as the Chesapeake & Ohio makes a junction with it. The branch is 31.5 miles in length and is now completed.

MANCHESTER & AUGUSTA.—A mortgage has been filed to cover the expense of constructing and equipping this road to Augusta, Ga.

Projects and Surveys.

NORTH CAROLINA.—W. H. Sikes, Swann's Station, N. C., is building a tram road 15 miles long to convey lumber and turpentine to the Cape Fear & Yadkin Valley road.

ATLANTIC, SUWANEE RIVER & GULF.—Incorporated in Florida to build a railway from Starke, Fla., to the Suwanee river; capital stock, $600,000; C. L. Peek, F. L. Babbitt.

INTERNATIONAL & SOUTH AMERICAN.—Incorporated in Florida to build a railway from the South Florida R. R. to the Gulf of Mexico; A. W. Gilchrist and J. G. Gibbs, Fernandina, Fla., are interested.

NORTH CAROLINA.—The citizens of Buncombe county will hold an election to vote on the issue of bonds for $200,000 to secure a railway from Asheville, N. C., to Bristol, Va., or some other point on the Norfolk & Western.

TENNESSEE.—W. A. Bowie, Chattanooga, has completed an observation survey for a railway in this state from Bristol southward to Knoxville, and thence to Birmingham, Ala., and Jacksonville, Fla. The proposed road will be 40 miles shorter than the present one between Bristol and Knoxville.

WESTERN PENINSULAR.—It is reported that this road, incorporated to extend from Tampa Bay, Fla., to Valdosta, Ga., will connect with the Georgia Southern & Florida or will become a part of the East Tennessee system.

Northwest—Existing Roads.

GREAT NORTHERN.—The grading of the extension from Park Rapids to Leech Lake, Minn., is reported as about completed. The Mayville branch was completed to Blanchard, N. Dak., last fall, leaving 12 miles to be rebuilt. This has now been recommenced by Foley Bros. & Guthrie, St. Paul, the contractors, and the line is expected to be completed next month.

Southwest.—Existing Roads.

AUSTIN & NORTHWESTERN.—Surveys have been made for an extension of this road in Texas from Marble Falls to Mason, a distance of 40 miles.

GULF, BEAUMONT & KANSAS CITY.—It is reported that the contract has been awarded for the first 20 miles of this road, to be built northeasterly from Beaumont, Tex., and that the construction has been commenced. The line will run through pine forests and granite fields.

GULF, COLORADO & SANTA FE.—The eastern extension of this line is graded from Cleveland, Tex., 17 miles toward the Trinity river, and will probably connect with the proposed Gulf, Beaumont & Kansas City road in the vicinity of Concord or Kountze, in Hardin county. B. M. Temple has completed the survey for a railway from Cunningham's sugar refinery, in Fort Bend county, to Arcola Junction, a distance of 12 miles.

PARAGOULD & BUFFALO ISLAND.—A syndicate, headed by J. F. Hasty & Sons, Paragould, Ark., has purchased this road, and will change it to standard gage, according to reports.

TEXAS CENTRAL.—W. H. Gould, Waco, Tex., Res. Engr., has surveyed a third line for an extension of this railway from Albany, Tex., to some place in New Mexico. The report will be submitted to the directors at the next meeting.—Land has been purchased at Waco for removing the southeastern terminus of this road from Ross to that city, which will involve an extension of 12 miles.

UNION PACIFIC.—This company will be asked to operate a railway that is now being surveyed by the Maxwell Land Grant Company, to extend from Raton to Catskill, N. Mex., a distance of 15 miles.

Projects and Surveys.

TEXAS.—The Minerva Colliery Co., which operates extensive coal mines in Webb Co., is reported as about to construct a railway to connect with the Mexican National. The company has purchased the old grade of the Mexican National and ordered 67,000 ties.

Rocky Mt. and Pacific.—Existing Roads.

BURLINGTON & MISSOURI RIVER.—The contract for extending this road from the Yellowstone river to Butte City, Mont., is reported to have been awarded. According to reports, the road has been constructed to near Billings, Mont., and work is being pushed in a northwesterly direction.—The extension to Spearfish, in S. Dak., is expected to be completed by September, and there is talk of extending the line to Sundance, Wyo., 35 miles from Spearfish.

BURRARD INLET & FRASER VALLEY.—The contract for clearing the first section of this railway, which is to connect Vancouver, B. C., with the Northern Pacific, 4.7 miles distant, has been awarded to G. W. Thomas, Vancouver. This section includes the first four miles from Vancouver, and is the heaviest piece of clearing in the line. Other contracts will soon be awarded. Pres., C. D. Rand, Vancouver, B. C.

CANADIAN PACIFIC.—A report from Victoria, B. C., states that the contract has been awarded for clearing the right of way for a branch of this road from Revelstoke to Arrow Lake, in the Kootenai district.

DENVER, LONGMONT & NORTHERN.—It is reported that the surveyors are at work upon the proposed route of this road, and the contract for building and equipping it has already been awarded to Norman Gifford, of Chicago. The road is to be 13 miles in length, and will run through some fine stone quarries. George W. Skinner, L. H. Quimby, Ed. R. Perkins, S. A. Williams and Charles Bradt, of Denver, are interested.

NEVADA SOUTHERN.—Isaac E. Blake, Pres. Continental Oil Co., Denver, has been in New York trying to secure an extension of this railway from The Needles into Iron county, in southwestern Utah, across Nevada. The road is now being built northward from The Needles, along the California side of the Colorado River. The proposed extension would be 175 miles long, and cost $4,500,000. It would meet the main line at Good Spring, Nev.

NORTHERN PACIFIC.—A press dispatch from the state of Washington claims that this road is to be extended west from Coulee City to the Columbia River, also that the proposed extension includes a branch up the river valley to the Methow Creek mining district.

Projects and Surveys.

MIDLAND RY. OF ARIZONA.—The first and second mortgage bonds of this company were filed at Prescott, Ariz., June 22. The proposed road is 105 miles long, and will tap the section between Prescott and Phoenix. The construction will soon be commenced, according to reports.

RAWLINS & BILLINGS.—Preliminary surveys have been made for a railway from Rawlins, Wyo., to connect with the Northern Pacific at Billings, Mont. The scheme proposes an air line from Portland to Denver and the Gulf. J. D. Negus is the promoter of the enterprise.

STOCKTON & BAKERSFIELD.—A prospectus has been issued for a railway in California between Bakersfield and Stockton, a distance of about 230 miles. It is also proposed to continue the road from Stockton to San Francisco. The road would pass through the San Joaquin Valley, have grades of not more than 16 ft. per mile, and cost less than $20,000 per mile, track laid with 63-lb. steel rails, according to the prospectus.

STREET RAILWAYS.

DEDHAM, MASS.—The Norfolk Surburban St. Ry. Co. has filed its papers preliminary to a charter, with the railroad commissioners, for a road from Dedham through Hyde Park to Mattapan, there to connect with the West End road. The road will be about 7½ miles long, and the capital stock will be $75,000.

HAVERHILL, MASS.—The Nashua & Haverhill Electric Ry. Co. proposes an electric railway between this city and Nashua, N. H., a distance of 22 miles.

HOLBROOK, MASS.—Messrs. Thayer and Potter, of South Braintree, representing a street railway company that proposes to construct a belt line electric road connecting the towns of Braintree, Randolph and Holbrook, and completing the circuit from Brockton to Boston, have petitioned for a franchise to lay tracks through this town. If the company means business it is stated that the franchise will be granted, as the people desire to have the road built.

MILLBURY, MASS.—The Blackstone Valley St. Ry. Co. has been granted a franchise for an electric railway in this town, and it is expected that the construction will soon be commenced, and the road completed in three months.

HARTFORD, CONN.—The Hartford & West Hartford Horse R. R. Co. has been authorized to use electricity as motive power, and to extend its line to Farmington, and to connect at the town lines for New Britain and Plainville.

NORWALK, CONN.—The Norwalk Horse R. R. Co. has been granted permission to double track its road from Winnipauk to South Norwalk, and to use electricity as motive power.—The Norwalk Tramway Co. has been authorized to extend its road to Westport, to New Canaan, to Darien and Stamford, to Roton Point, with a connecting branch to Darien, over many additional streets of this city, and to have numerous branches, in all more than 30 miles of track.

AMSTERDAM, N. Y.—Surveys are being made for an electric railway to Gloversville and Johnstown; estimated cost, $200,000. Lewis Caten, formerly Supt. Fonda, Johnstown & Gloversville R. R., is interested.

RHINEBECK, N. Y.—It is reported that contracts will soon be awarded for an electric street railway at this place.

SING SING, N. Y.—The syndicate owning the electric railway is reported as proposing to extend the line eastward to Pleasantville.

DOWNINGTOWN, PA.—Surveys are nearly completed for the West Chester & Downingtown Electric Ry., between this city and West Chester. J. D. Lindsay and Geo. J. Reid, of New York, are interested.

PITTSBURG, PA.—The Pittsburg, Crafton & Mansfield St. Ry. Co. has been incorporated with a capital stock of $500,000, to construct an electric railway ten miles in length. It will extend from this city through the boroughs of Elliott, Chartiers and Mansfield. Pres., J. C. Reilly; directors, T. S. Bigelow, William J. Burns, J. D. Callery, W. J. White, Pittsburg.

TOWANDA, PA.—A franchise has been granted to a company represented by G. W. Kipp and E. F. Kizer, electric motive power to be used.

LAUREL, MD.—The city council has granted a franchise to the Baltimore & Washington Tramway Co.

KNOXVILLE, TENN.—A charter has been granted to the Knoxville Electric Ry. Co. to build an electric railway from this city to London, Clinton, Kingston and other places. There is talk of a road between Harriman and Kingston to connect with this.

NASHVILLE, TENN.—The council has passed to second reading a bill authorizing the Nashville & West Nashville Ry. Co. to change from steam to electric motive power.

CLEVELAND, O.—The Cleveland Cross-Town St. R. R. Co. has been incorporated by S. H. Short, J. Potter, L. A. Russell and others; capital stock, $10,

000.——The West Side & Gordon Park St. R. R. Co. has been incorporated by W. C. Scofield, C. W. Scofield, S. H. Short and others; capital stock, $10,000.

YOUNGSTOWN, O.—The Orient Electric Co. has been incorporated to construct an electric railway from this city to Lauterma's Falls; capital stock, $60,000. L. T. Foster is interested.

JEFFERSON, ILL.—The county board of Cook Co. has granted a 20-year franchise to the Jefferson Electric St. Ry. Co. for an extensive system of electric railways. The ordinance provides that the road shall be completed within two years, cars heated by steam, and that any other motive power than electricity can be used.

ASHLAND, WIS.—The Ashland Lighting & Electric St. Ry. Co. is about to extend its line 2½ miles.

DENVER, COLO.—The Pleasure Resort Electric Ry. Co. proposes to build an electric railway to connect with the north and west lines of the City Cable Co., and taking in all the North-side resorts. Pres., E. F. Sommers; Treas., C. C. Skiles; Secy., W. Thorn

HIGHWAYS.

MASSACHUSETTS.—The city council of Newton has accepted the report of the highway committee recommending that a boulevard and parkway be constructed from the Boston line to West Newton, and has passed the preliminary orders for the construction; proposed width, 120 to 140 ft.; length, 4.12 miles; estimated cost about $250,000.

OHIO.—Bids will be received until July 12 for excavating and grading the Olivesburg road, near the Ohio reformatory. J. F. Seward, Co. Aud., Mansfield.

——The commissioners of Hamilton Co. have been authorized to spend $100,000 for improving East Court St., for which plans have been prepared by the city engineer of Cincinnati. The roadbed, 20 to 30 ft. wide, will be paved with cobblestones for a distance of 1,600 ft., and considerable cutting will be required; estimated cost, $115,000.

BRIDGES.

SALEM, MASS.—Bids are asked by the committee on streets and bridges until July 17 for the pile, timber and stone foundation for the new drawbridge in Union St.

HALLSTEAD, N. Y.—The county commissioners will build a bridge at Great Bend the coming summer.

HOOSICK FALLS, N. Y.—There is a possibility of a new iron bridge to cost about $16,000 being erected to replace the present structure.

ATLANTIC CITY, VA.—The city council has voted $17,000 for a bridge from Second St. to the Norfolk Co's. property.

MILWAUKEE, WIS.—The board of public works will receive bids until July 18 for a new bridge and viaduct over the Milwaukee River.

WATER-WORKS.

HANOVER, N. H.—The Hanover Water-Works Co. will receive bids until July 14 for an earth dam, about 16,000 cu. yds.; also for laying pipe, about two miles of mains and 4½ miles of distribution system.

BURLINGTON, VT.—The city council has been authorized to spend $50,000 for extensions, including an extension of the intake pipe, made necessary by the proposed extension of the sewer outlet.

BLANDFORD, MASS.—E. W. Boise and W. H. Outley are interested in securing a supply for the village. A well is being sunk by H. B. King, Hartford.

FALL RIVER, MASS.—A new pumping engine, probably not less than 8,000,000-gallon, will soon be purchased by the committees on finance and water-works.

MELROSE, MASS.—The town treasurer has been authorized to issue 4% bonds for $50,000, of which $15,000 will be sold at once for extensions. The question of an additional supply is being investigated.

WEST SPRINGFIELD, MASS.—N. T. Smith, Alexander Grant and W. F. Cook have been elected as water commissioners. The town has voted to issue bonds for $25,000 to secure a supply for residents of Mittineague.

HARTFORD, CONN.—C. H. Bunce, Engr., has reported that it will cost $278,462 to complete the Tumbledown Brook reservoir. The commissioners have already spent $141,928, and the city has been authorized to issue additional water bonds for $200,000.

ALDEN, N. Y.—The Alden Water-Works Co., noted June 23 as incorporated, has been granted a franchise.

FAIRPORT, N. Y.—The citizens voted July 1 in favor of works.

LOWVILLE, N. Y.—An election will be held July 18 to vote on the issue of bonds for $65,000 for works.

PERRY, N. Y.—A project for works is being discussed.

ROCHESTER, N. Y.—The executive board will receive bids July 11 for 15 flexible or ball socket joints for 60-in. riveted steel water pipe and 1,580 lin. ft. of such pipe. Extensions of mains have been authorized to cost $52,000.

CAMDEN, N. J.—The council is considering an ordinance providing for the issue of bonds for $300,000 for improving the supply.

COCHRANTON, PA.—The contract for works has been awarded to Chandler Bros. & Co., Beaver Falls, and that for the reservoir to J. B. Houser, Meadville. The total cost will be about $9,000.

DRIFTON, PA.—The following companies have been incorporated: Drifton Water Co., capital stock, $30,000; Beaver Meadow Water Co., $10,000; Oneida Water Co., $10,000. Works were built here in 1865 by Coxe Bros. & Co.

LLEWELLYN, PA.—The Sheafer's Creek Water Co. has been incorporated; capital stock, $16,000.

PITTSBURG, PA.—The following bids have been received for the construction of two 10,000,000-gallon pumps at Brilliant Station: Geo. F. Blake Mfg. Co., port, N. Y., $147,820; Snow Steam Pump Works, Buffalo; $137,919; Edward P. Allí Co., Milwaukee, $204,-falo, $137,919; Edward P. Allis Co., Milwaukee, $204,-000; Henry R. Worthington, New York, $170,000; Southwark Foundry & Machine Co., Philadelphia, $147,902; Wilson Snyder Mfg. Co., Pittsburg, $156,700.

POTTSVILLE, PA.—The contract for the Kaufman dam has been awarded by the Pottsville Water Co to Thos. F. Kerns.

RED LION, PA.—The Red Lion Water Co. has been incorporated to secure a supply; capital stock, $10,000.

HAGERSTOWN, MD.—The Washington County Water Co. has decided on a partial adoption of the meter system.

EASTMAN, GA.—It is reported that works will soon be put in.

VALDOSTA, GA.—The city has completed a well 522 ft. deep, 10,000 gallons capacity, and desires bids for a pump to lift the water from the well to a standpipe 100 ft. above the surface. Mains have not yet been laid.

DAYTON, O.—The water-works trustees have decided to purchase a 15,000,000-gallon Gaskill high duty horizontal compound pumping engine of the Holly Mfg. Co., Lockport, N. Y., at $53,975. The contract will not be awarded until bonds have been sold.

HAMILTON, O.—The city council has voted to issue bonds for $12,000 for extensions.

NILES, O.—The trustees are arranging to increase the capacity of the well system.

EAST CHICAGO, IND.—The East Chicago Water-Works Co. has been incorporated at Chicago to construct works here; capital stock, $100,000; Newton P. R. Hatch, John O. Staftes and Edward R. Conant.

HUNTINGBURG, IND.—The contract for a reservoir has been awarded to Martin Cummings and Fred Hanger, New Albany.

BIG RAPIDS, MICH.—It is reported that the council has contracted with G. F. Waring for a system of 2-in. wells.

IRONWOOD, MICH.—M. T. Dozer, Cy. Engr., Ashland, Wis., informs us that a pipe line is being agitated in this city and Hurley, Wis., from Lake Superior, about eight miles distant, or Ashmead mineral springs, about 40 miles distant. The present supply for both cities is pumped from the Montreal River and is not satisfactory.

LAKE CITY, MICH.—The contract for works has been awarded to Thos. Botham, Winona, Minn., at about $22,000.

SAULT STE. MARIE, MICH.—Bids are asked until July 20 for a stand-pipe, 35 x 80 ft., and 2,000 ft. of iron intake pipe. Geo. S. Pierson, Consult. Engr., Kalamazoo.

JERSEYVILLE, ILL.—The city council has decided to use meters, and has authorized the purchase of a supply.

KEITHSBURG, ILL.—The following bids have been received for constructing works: M. W. McCullough, Monmouth, $14,200; T. H. Brown, Chicago, $14,454. Chas. F. Sturtevant, Consult. Engr., St. Louis, Mo.

ASHLAND, WIS.—The present supply is taken from Chequamegon Bay, about one mile from shore, and it is proposed to extend the intake about eight miles to Lake Superior or to bore artesian wells, several of which have already been sunk by private parties, or to extend the pipe to Ashland mineral springs, about two miles from the center of the city. M. T. Dozer, Cy. Engr.

GREEN BAY, WIS.—Gray Bros., Milwaukee, have been awarded a contract for another well.

LA CROSSE, WIS.—Contracts for laying mains have been awarded to J. A. Trane, at $12.200, and to R. F. Weston, at $4,970.

MAPLETON, IA.—Bids have been opened for works.

FREMONT, NEB.—The contract for a stand-pipe, 15 x 105 ft., has been awarded to J. H. Davenport, Fremont.

NEW CASTLE, COLO.—The contract for mains for the new works has been awarded to F. W. Adams, of this city.

PUEBLO, COLO.—An ordinance has been introduced in the council providing for the issue of bonds for $1,000,000 for the purchase of works.

PUYALLUP, WASH.—An election will be held Aug. 1 to vote on the issue of bonds for $60,000 for works.

SPOKANE, WASH.—An election will be held July 25 to vote on plans for new works, estimated to cost $320,700. The plans include a dam 12 ft. high in the Spokane River and 21,400 lin. ft. of 20-in. main, at $5.50 per lin. ft.

SUMNER, WASH.—An election was held July 3 to vote on the question of works, estimated to cost $17,000.

TACOMA, WASH.—The city has purchased the plant of the Tacoma Light & Water Co., valued at $2,000,000.

WALLA WALLA, WASH.—An election will be held July 27 to vote on the issue of bonds for $160,000 for works, for which plans have been prepared by W. Kiersted, Kansas City, Mo.

DALLAS, ORE.—The committee on fire and water has been instructed to correspond with engineers with regard to plans for works, for which the town has been authorized to issue bonds for $30,000.

NAPLES, CAL.—The Dos Pueblos Water Co. has been incorporated by J. H. Williams, A. P. Williams, J. P. Brown and others; capital stock, $300,000.

PASADENA, CAL.—The Raynor Springs Water Co. has been incorporated by A. C. Armstrong, A. W. Armstrong, C. W. Rogers and others; capital stock, $105,000.

WILLOW SPRINGS, CAL.—The Willow Springs Water Co. is being organized by Stewart Reed and others to secure a supply for residents of the Iowa Valley.

FOREST DALE, UTAH.—Geo. M. Cannon, representing the Forest Dale Water Co., has accepted a franchise to lay mains at this place.

COWANSVILLE, QUE.—It is reported that works will soon be put in. There will be 4½ miles of pipe, and the estimated cost is $27,500.

ARTESIAN WELLS.

IPSWICH, S. DAK.—The village council is considering the advisability of procuring another well to secure an additional supply of water.

IRRIGATION.

NEW COMPANIES.—Owyhee Land & Irrigation Co., Providence, R. I.; $1,500,000; C. L. Wing, Grand View, Idaho, Agt. for Idaho.——Fair View Reservoir & Irrigation Co., Fair View, Utah; $300,000.——Columbia River Irrigation & Impvt. Co., Kiona, Wash.; $100,000.——Clear Creek Ditch & Storage Co., Denver, Colo.; $250,000.

SEWERS.

BOSTON, MASS.—The contract for pumping plants at East Boston and Deer Island has been awarded by the Metropolitan Sewerage Commission to the Edward P. Allis Co., Milwaukee, at $47,000 each. Four triple-expansion engines will be required. The bids were published in our issue of June 8.

BROCKTON, MASS.—Bids will be received until July 17 for the construction of the pumping station, gatehouse, screenhouse and chimney for the city sewerage system. F. H. Snow, Cy. Engr.

HOLYOKE, MASS.—It is reported that bids will soon be asked for the proposed Elmwood and Oakdale sewers.

NORTH BROOKFIELD, MASS.—The selectmen are investigating the systems of other places, preparatory to taking up the question here.

WEST HARTFORD, CONN.—The selectmen have been appointed as a commission to construct sewers. T. E. Stanley and W. C. Goodwin are members.

BUFFALO, N. Y.—Bids will be received by the board of public works until July 13 for constructing 18, 12 and 10 in. tile sewers in three streets.—The board of public works received the following bids for six sewers: Patrick Battel, $6,582; John Mumm, $10,228; Thos. McKeown, $10,300; E. J. Green, $11,447; A. D. McConnell, $11,044; MacGregor & Hughes, $10,986; Otto Faerber, $10,443; Christ Knobloch, $10,700; Thos. B. Reading, $11,000; F. J. Martin, $10,958; Jacob Ritzmown, $11,300; Henry Keblin, $13,300; Henry Harter, $10,161; William Franklin, $11,000; August Gisel, $10,-850; W. A. Green, $11,848; W. G. Smith, $10,848.

CAZENOVIA, N. Y.—The plans prepared by the Stanwix Engineering Co., Rome, for a system have been completed and will be submitted to the state board of health.

KINGSTON, N. Y.—The city engineer has reported plans for a system in wards 2 and 9; estimated cost, $179,000.

NEW YORK, N. Y.—The board of public works will receive bids until July 13 for three contracts.

ROCHESTER, N. Y.—The contract for the Goodman and Clifford Sts. outlet sewer has been awarded to Lauer & Hagaman, at $31,324.

ROME, N. Y.—Chas. C. Hopkins, Cy. Engr., informs us that plans for a complete system were presented to the council last winter, but the question of issuing bonds for the construction has not yet been submitted to a vote of the taxpayers.

SYRACUSE, N. Y.—The council has directed the city engineer to prepare plans for 18, 15 and 12-in. tile sewers in four streets.

MONTCLAIR, N. J.—Bids will be received until July 10 for 4,965 ft. of 24-in. and 1,960 ft. of 18-in. pipe sewers, as stated in our advertising columns. Henry L. Yost, Tp. Clk.

HARRISBURG, PA.—The council has authorized the construction of terra-cotta pipe sewers in six streets.

JOHNSTOWN, PA.—The council has authorized the construction of three sewers and the extension of three.

PHILADELPHIA, PA.—Contracts have been awarded as follows: Jas. Sullivan, Gunner's run sewer, $175,-000; J. H. Covode & Co., Aramingo canal, $75,000; G. W. Rusch, reconstructing connecting sewer, $15,000, and Wolf creek sewer, $75,000; K. & D. Dooley, American creek sewer, $15,000; Wm. Moss, Meadow creek sewer, $6,500.

READING, PA.—The committee on sewers is reported to have recommended to the council the system of sewage disposal in use at Pullman, Ill., and the council has directed the committee to inspect grounds below the city with a view of locating filtering beds.

CHARLOTTESVILLE, VA.—Rudolph Hering, New York, has prepared plans for a gravity system; estimated cost, $80,000.

SUNBURY, PA.—A company has been incorporated to construct a system; Pres., Lewis Dewart; Secy., Gilbert Burrows.

ROANOKE, VA.—The contract for about ten miles of pipe sewers has been awarded to Sims, Dyer & Co., at about $30,000.

HUNTINGTON, W. VA.—W. E. Williams, Engr. Cabell Co., informs us that this city has voted to issue $50,000 in bonds for sewers.

MONTGOMERY, ALA.—It is reported that sewer work to cost $75,000 is contemplated.

NASHVILLE, TENN.—The Nashville Sewerage Co. has been incorporated by B. Gilbreath, M. Hillman, D. C. Scales, W. C. Drake and Robert W. Waller.

COVINGTON, KY.—It is reported that the city engineer has been instructed to prepare specifications and to advertise for bids for the Willow Run sewer; estimated cost, $100,000 to $200,000.

NEWPORT, KY.—Bids will be received until July 13 for $40,500 worth of sewer bonds. Jas. H. Smith, Cy. Treas.

DELPHOS, O.—Plans for a trunk sewer system are being prepared by G. L. McKibben, Cy. Engr., Van Wert.

TOLEDO, O.—The committee on sewers has voted to build 11 pipe sewers.

FRANKFORT, IND.—Professor Phillips, of Purdue University, is assisting Chas. H. Brown and the city engineer in making surveys for a system.

SOUTH BEND, IND.—Bids will be received until July 24 for 11,200 ft. of 24 to 90-in. sewers. Wm. M. Whitten, Cy. Engr.

ST. JOSEPH, MICH.—Bids will be received until July 10 for about 12,000 lin. ft. of sewers, as stated in our advertising columns. Geo. E. Smith, Secy. Bd.

HINSDALE, ILL.—Bids will be received until July 10 for about 12,000 lin. ft. of 3-ft. main sewer and several lateral sewers. E. P. Hinds, Pres. Vil. trustees.

JOLIET, ILL.—It is reported that the council is considering a new sewerage system to cost about $373,000.

LINCOLN, ILL.—A. H. Bell, Bloomington, is preparing plans for a system.

KAUKAUNA, WIS.—It is reported that bids are being received for seven miles of sewers.

BOONE, IA.—The council has engaged Col. G. E. Waring to prepare plans for a system.

FORT DODGE, IA.—The contract for sewers has been awarded to Farrant & Scollard, Sioux City, at about $10,000.

DULUTH, MINN.—The board of public works will receive bids until July 10 for a sewer in one street.

INDEPENDENCE, MO.—Geo. P. Gates and J. H. Taylor are members of a committee appointed to urge the council to prepare surveys and plans for a system.

ROSLYN, WASH.—L. F. McConihe informs us that surveys are being made by Ogden & Bosworth, Tacoma, for a complete system.

SEATTLE, WASH.—R. H. Thomson, Cy. Engr., informs us that bonds for $250,000 have been voted for sewers. The work will probably be done by day labor under the direction of the street commissioner, and will include a brick intercepting sewer 32 × 48 to 20 × 30 ins., and 18 to 16-in. pipe sewers.

TACOMA, WASH.—Jas. M. Morrison, Cy. Engr., informs us that the bond issue of $500,000, recently voted, has been declared illegal by the state supreme court, and that the construction of the proposed sewers has been therefore indefinitely postponed.

STREETS.

WEST HARTFORD, CONN.—Three streets will be macadamized.

BROOKLYN, N. Y.—Bids will be received until July 11 and 12 for repaving, with asphalt, one street at each date. John P. Adams, Comr. Cy. Wks.

BUFFALO, N. Y.—The council has voted to have several streets paved with asphalt and brick.

NEW YORK, N. Y.—The board of public works will receive bids until July 13 for paving 13 streets with granite blocks and nine with asphalt. These streets complete the list of those that are to be paved out of the special $1,500,000 this year.

ROCHESTER, N. Y.—The contract for paving Platt St. with Medina blocks has been awarded to Bruff, Horn & Co., at $26,380.

SYRACUSE, N. Y.—Bids are asked until July 10 for paving 1 street with macadam, 2 with brick and 3 with Trinidad Lake asphalt.——The contract for paving two streets with asphalt has been awarded to the Syracuse Improvement Co., $120,639. H. F. Stephens, Cy. Clk.

NEWARK, N. J.—The board of public works has passed ordinances for paving five streets with granite blocks.

NEW CASTLE, PA.—The council has voted to pave two streets.

PHILADELPHIA, PA.—The board of health has adopted specifications for paving with cement all alleys which have been declared public nuisances by reason of defective paving or insufficient drainage. They must be dug out to a depth of 18 ins. below the surveyor's lines, filled in with 14 ins. of clean cinders, well rammed, upon which concrete is to be laid, and finished off with a cement top.

WILMINGTON, DEL.—The street and sewer department will receive bids until July 8 for re-setting curbs, paving gutters, etc., during 1893.

CLEVELAND, O.—The council has voted to pave ten streets.

FOSTORIA, O.—The contract for paving Main St. with East Clayton brick has been awarded to the Standard Construction Co., Columbus, at $18,267.

HAMILTON, O.—Bids are asked until July 11 for paving one street with brick. J. J. McMaken, Cy. Clk.

MARIETTA, O.—The council has voted to improve three streets, including one to be paved with brick.

NORWOOD, O.—The contract for paving Park Ave. with asphalt has been awarded to the Warren-Scharf Asphalt Paving Co., at about $19,000.

SOUTH BEND, IND.—The council has voted to construct the 20,000 sq. yds. of brick pavement referred to last week, and bids will be received until July 24 for the work. Wm. W. Whitten, Cy. Engr.

ASHLAND, WIS.—The council has ordered plans prepared for paving about 20 streets with cedar blocks. M. T. Dozer, Cy. Engr.

KANSAS CITY, MO.—The Barber Asphalt Paving Co. has been awarded four contracts at $103,427. Additional work has been ordered.

SEATTLE, WASH.—A contract for improving two streets has been awarded to J. S. McCormick, at $19,454, and for grading one to H. M. Byerly, at $15,209.

PASADENA, CAL.—Bids will be received until July 17 for paving estimated to cost $70,000.

TORONTO, ONT.—The city engineer has recommended the following work: Paving 4 streets with asphalt, estimated cost $60,630; 5 with cedar blocks, $17,450; 1 with tamarac blocks, $7,700.

ELECTRIC LIGHT AND POWER.

JACKSONVILLE, FLA.—It is reported that W. D. Wilson, Tampa, represents a company that proposes to put in an electric light plant in this city; capacity, 2,250 incandescents and 150 arc lights.

FINDLAY, O.—Bids are asked until July 17 for 100 or more 2,000-c. p. arc lights for five years. S. P. De Wolfe, Cy. Clk.

MADISON, WIS.—Bids are being received for public lighting and for a municipal electric light plant.

OAKLAND, CAL.—The city trustees will receive bids until July 17 for a franchise for incandescent lightlig.

NEW COMPANIES.—Knickerbocker Electric Light & Power Co., Flatubsh, N. Y.; $30,000; Richard Ficken, Flatbush; Thos. Murtha, Richard Ulman, New York.——& Power Co., Portland, Ore.; $500,000; H. Wittenberg, chett, A. A. Worsely, C. Satterlee.——Portland Heat & Power Co., Portland, Ore.; $500,000 ;H. Wittenberg, J. T. Barron, D. W. Crowley.——Farrall Electric Heat & Light Co., New York; $1,000,000; Mfg. Theophilus Farrall's patent apparatus for electric heating and lighting. —Suburban Electric Co., Wheeling, W. Va.; $100,000.——Albert Lea Electric Co., Albert Lea; Minn.; $35,000; Mfg. electric light and power; operating telephones and street railways, etc.——Elsinore Electric Power & Water Co., Elsinore, Cal.; $200,000.

CONTRACT PRICES.

PIPE.—Montreal, Que.—The contract for 1,430 gross tons of cast iron pipe has been awarded to the Canada Pipe & Founding Co., at $37 per ton.

BRICK.—Wilmington, Del.—The water commissioners have awarded the contract for 600,000 to 1,000,000 brick for the new filter to Beeson, Hanby & Bros. at $7.95 per M. Beggs & Allmond bid $8.50.

SAND.—Baltimore, Md.—The following bids were received for sand for repaving East Lexington St.: George Judge, 49 cts. per cu. yd.; M. Wachter, 50 cts.; Patrick Keelty, 53 cts.; J. W. Parks, 54 cts.; Jos. Fallon, 54 cts.; J. C. Boyd, 55 cts; Murphy & Sweitzer, 57 cts.; Jos. Gallagher, 57 cts.; John J. Gallagher, 59 cts.; Frank Imbach, 59½ cts.; J. J. Kain, 62 cts.; A. Kemmers, 63 cts.; R. E. Slaine, 70 cts.; Henry Kline, 75 cts.

DREDGING.—Brooklyn, N. Y.—The lowest bid for dredging about 100,000 cu. yds. in the Wallabout channel at the Brooklyn navy yard was that of Dennis Hurley, representing the Wm. H. Bland Dredging Co., New York, at 27.5 cts. per cu. yd.

REMOVING MUCK.—Newburg, N. Y.—The contract for removing 140,000 cu. yds. of muck from Washington Lake has been awarded by the water commissioners to Babcock, Lary & Co., at 28 cts. per cu. yd. Upon the opening of bids, at a previous meeting of the commissioners, Babcock, Lary & Co. had bid 30½ cts. for the work at Washington Lake and 40 cts. for that at Lockwood Basin, and I. T. Brown, New York, 28½ cts. for the entire work. The price of 28 cts. was a verbal bid made at the time of awarding the contract.

ASPHALT, BRICK AND CEDAR BLOCK PAVING.—Toledo, O.—For paving two streets, John Streicher bid $2.30 and $2.45 per sq. yd. for asphalt, $1.25 for Hallwood blocks, about $1 for vitrified brick, or 75 cts. for cedar blocks. The Warren-Scharf Asphalt Paving Co. bid $2.49 for asphalt.

STONE BLOCK PAVING.—Utica, N. Y.—The contracts for paving two streets with block sandstone have been awarded to the Warren-Scharf Asphalt Paving Co. at $2.75 and $2.85 per sq. yd W. W. Fowler bid $3.10 and J. W. Berry, $3.08.

ASPHALT AND CEMENT WALKS.—Washington.—D. C.—Contracts have been awarded as follows: H. L. McLaughlin, cement sidewalks, $1.735 per sq. yd.; Washington Asphalt, Block & Tile Co., asphalt tile sidewalks, $1.50 per sq. yd.

SEWERS.—Lawrence, Mass.—Arthur D. Marble, Cy. Engr., informs us the contract for the Water St. outlet sewer was awarded to (2) Andrew W. Byrne, Someville, at $41,358, as stated June 22, the other bids being as follows: 1, National Const. Co., Boston, $43,123; 3, Moulton & O'Mahoney, Lawrence, $50,411; 4, Fred. E. Shaw, Providence, $46,528. The prices follow:

	1.	2	3.	4.
Earth excav., 54-in. sewer, 370 lin. ft., at	$8.95	$10.00	$10.00	$8.00
Earth excav., 48-in. sewer, 917 lin. ft., at	7.80	7.50	9.00	7.00
Earth excav., 45-in. sewer, 322 lin. ft., at	5.50	5.50	6.00	6.00
Earth excav., 39-in. sewer, 405 lin. ft., at	3.60	4.00	3.50	5.00
Brick mas., Am. cem., 570 cu. yds., at	14.00	13.50	14.00	12.50
Brick mas., Portland cem., 170 cu. yds., at	16.00	15.00	16.50	15.00
Concrete mas., 50 cu. yds., at	6.20	6.00	7.50	6.00
18-in. pipe sewer, incl. m'holes, 595 ft., at	2.45	3.00	2.50	2.25
15-in. pipe sewer, incl. m'holes, 483 ft., at	1.98	1.75	2.25	2.00
10-in. pipe sewer, incl. m'holes, 940 ft., at	1.35	1.00	1.75	1.25
Brick sewer, 18 × 24 ins., 45 ft., at	2.00	3.00	2.50	3.50
Rubble masonry, 20 cu. yds., at	8.00	7.00	7.00	6.00
30-in. iron pipe, 444 l.n. ft., incl. 230 ft. under a canal, at	28.80	25.00	37.50	40.00
Spruce lumber in place, 40 M. ft., at	35.00	40.00	40.00	35.00
Rock excav., 50 cu. yds., at	6.00	6.00	25.00	6.00

Flushing, N. Y.—G. A. Roullier, Engr., informs us that the contract for sewers in Broadway and Flushing Place has been awarded to (2) Thomas P. Tuohy & Co., Flushing, the other bidders being (1) Robt. J. Mills, New York, and (3) E. E. Eglee, New York. The prices were as follows :

	1.	2.	3.
18-in. sewer, per lin. ft.	$2.73	$1.93	$2.25
15-in. " " " "	2.43	1.70	2.00
12-in. " " " "	1.98	1.20	1.35
9-in. " " " "	1.63	1.00	1.25
Flush tanks, at	135.00	150.00	185.00
Manholes, "	60.00	45.00	40.00
Basins, "	150.00	125.00	150.00
12 basin connections at	1.35	1.00	1.35
Junction chambers, "	25.00	30.00	10.00
Lumber, per M. ft., B. M.	30.00	20.00	20.00
Rock excav., per cu. yd.	3.00	5.00	5.00

MISCELLANEOUS.

PIER.—New York, N. Y.—The dock commissioners have voted to build a new pier at the foot of Stanton St., East River, to cost $40,000.

PIER WORK.—Ottawa, Ont.—Bids are asked until July 21 for the extension of piers at Port Stanley, Elgin Co. E. F. E. Roy, Secy. Dept. Pub. Wks.

BONDS.—Detroit, Mich.—Bids are asked until July 11 for $100,000 each of boulevard and park improvement bonds. C. W. Moore, Cy. Cont.

IMPROVEMENT BONDS.—Manchester, N. H.—Bids have been opened for $100,000 of 20-year improvement bonds

DREDGING, ETC.—Duluth, Minn.—Bids are asked until July 14 for dredging and repair of timber revetment at the Portage Lake Ship Canals, Michigan. Maj. Clinton B. Sears, U. S. Engineer Office.

RETAINING WALL.—Cohoes, N. Y.—The city engineer is preparing plans for a retaining wall, for which bids will soon be asked

JETTY.—San Francisco, Cal.—Bids will be received at the U. S. Engineer Office until July 21 for a jetty at San Diego harbor. Lieut.-Col. W. H. H. Benyaurd, U. S. A.

IRON CELLS.—Cleveland, O.—Bids are asked until July 15 for removing old stone cells and constructing new iron and steel cells in the second and third precinct police stations. N. C. Pollner, Dir. of Police.

GAS COMPANY.—Flatbush, N. Y.—The Flatbush & Flatlands Gas Light Co. has been incorporated by Jas. Hardee, J. A. Walsh and Henry Joseph; capital stock, $30,000.

CANAL IMPROVEMENTS.—Albany, N. Y.—We are informed by Edward Hannan, Supt. Pub. Wks., that the successful bidder for lengthening Lock 19, Erie Canal, was John J. Hallock, Syracuse, at $29,459. The bids for other work advertised to be let June 30 were rejected.

HARBOR IMPROVEMENTS.—Sheboygan, Wis.—The council has passed a resolution looking to the widening of the inner portion of the harbor about 100 ft. This will require about 2,200 ft. of crib work and cost over $50,000.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., are building a number of ten-wheel engines for the Central of New Jersey.

The Brooks Locomotive Works, Dunkirk, N. Y., have orders for 10 freight engines for the Peoria & Eastern, and have completed 5 six-wheel switching engines for the Toledo & Ohio Central.

The Schenectady Locomotive Works, Schenectady, N. Y., have delivered 6 eight-wheel engines to the Maine Central, and are building 6 fast passenger engines for the Cleveland, Cincinnati, Chicago & St. Louis.

The Indian Mountain Coal Co., Jellico, Tenn., will purchase a narrow gage engine.

CARS.—The Laconia Car Co., Laconia, N. H., is building 12 passenger cars, 5 baggage cars, 3 smoking cars and 2 construction cars for the Maine Central.

The Northwestern Car Co., Detroit, Mich., is erecting a shop 100 × 380 ft. at Oskosh, Wis.

The Mount Vernon Mfg. Car Co., Mount Vernon, Ill., has voted to increase its capital stock by $50,000.

The Jewett Car Co., Jewett, O., has been organized to manufacture cars for street and steam railways, and is erecting its first shop, 50 × 250 ft.

ROAD ROLLERS.—Pope reversible road rollers have recently been purchased as follows: Sheboygan, Wis., 7-ton; G. Howard, Asst. Q. M., U. S. A., Essex Junction, Vt., 5-ton; Corinth, Miss., 3½-ton; Montpelier, Ind., 6-ton; Ishpeming, Mich., 5-ton. Two of the Pope rollers, 3½ and 7 tons, respectively, are on exhibition at the World's Columbian Exposition, and are entered for competition with steam and all other road rollers. They are manufactured by the Union Iron & Foundry Co., of St. Louis, Mo., and sold by R. C. Pope, Chamber of Commerce Building, Chicago.

TAPPING MACHINE.—One of the A. P. Smith tapping machines has recently been purchased by the city of St. Louis, Mo., to be used for tapping water mains under pressure for all kinds of service. This device, which is now in use in a number of the larger cities and towns, is manufactured by A. P. Smith, of Newark, N. J.

SHIPBUILDING.—The New York Shipbuilding & Engine Co. will establish a ship yard at Whitestone, N. Y. Pres., E. A Stevens (Hoboken Ferry Co.); Supt.-Eng., C. D. Mosher; Nav. Archt., William Gardner.

THE PHILADELPHIA ENGINEERING WORKS, Philadelphia, Pa., have the following orders for their Corliss engines under erection: One 18 × 36-in. for the Pennsylvania R. R.; one 22 × 48-in., for Delaware County Construction Co., Clifton Heights, Pa.; one 12 × 30-in., for Harrisburg School Board, Harrisburg, Pa.; one 14 × 36-in., for Trenton Cotton Mills, Gastonio, N. C.; one 12 × 30-in. for Chatham Mfg. Co., Elkin, N. C.; one 16 × 42-in. for the Colorado City Glass Co., Colorado City, Colo.; one 26 × 50 × 54 cross compound condensing, for the Pennsylvania General Electric Co.

THE ABENDROTH & ROOT MFG. CO., New York, reports a lively demand for Root's patent spiral riveted water pipe from foreign countries, and has recently shipped a large supply of this pipe to South Africa.

THE D'ESTE & SEELEY CO., of Boston, reports a large order for Curtis balanced steam traps from the Geo. W. Newell Co., Philadelphia.

THE FISHER GOVERNOR CO., Marshalltown, Ia., has an exhibit of steam pumping engine governors, gravity governors and reducing valves, in the Machinery Building of the World's Columbian Exposition; Sec. 25, Column M. 24.

THE PENN BRIDGE CO., Beaver Falls, Pa., has lately been awarded a contract for a skew girder bridge at Columbus, O., with six girders, varying in length from 65 ft. 6 ins. to 116 ft. 6 ins.; total width, 82 ft. 6 ins. Also a truss span at Meadville, Pa., of one span 225 ft., 20 ft. roadway, and two 6-ft. walks.

THE BUFFALO STEAM PUMP CO., Buffalo, N. Y., is moving its plant to new and larger shops at Tonawanda, N. Y., and will retain an office at Buffalo. The company has completed a large pumping engine for forcing water through 12 miles of pipe and against a head of 650 ft. to supply a mine in Oregon with fresh water.

THE BUFFALO BRIDGE & IRON WORKS, Buffalo, N. Y., report contracts for the Mohawk aqueduct work and the Water St. bridge at Albany, for the New York state canals, and a contract for iron work for the Union Car Works, at Depew, N. Y.

NEW COMPANIES.—Whitely Malleable Casting Co., Muncie, Ind.; $200,000; John Whitely, A. F. Patterson and G. F. McCollough. The Commercial Enterprise Co., New York, N. Y.; $25,000; to build railways, wharves, etc.; William Bouldin, East Orange, N. J.; R. S. Masterson, Nyack, N. Y.; Charles Wendell, Brooklyn, N. Y. Beatrice Paving & Building Brick Co., Beatrice, Neb.; $80,000; Pres., W. H. Duffett; Secy., C. E. White, Duquesne Tin Plate Works, Pittsburg, Pa.; $10,000; Charles Dreifus and Jacob Wildberg. St. Louis & Collinsville Construction Co., Collinsville, Ill.; $10,000; Joseph Lunaghi, W. U. Faxon and Alex. Young. Dallett Iron Co., New Bound Brook, N. J.; $50,000; Frederick Dallett, East Orange, N. J.; John B. Coryell, Corning, N. Y. National Railway & Equipment Co., Atlanta, Ga.; $1,000,000; F. W. Miller and J. C. Bryan. Variable Speed Friction Mfg. Co., St. Louis, Mo.; $50,000; T. J. Reany, J. O. Broadhead and J. B. Sledon. T. T. Dickason Co., Chicago, Ill.; $250,000; lumber, railway ties and telegraph poles; L. T. Dickason, Wm. P. Reem and Charles J. Wright. National Boiler Works, Chicago, Ill.; $100,000; R. A. Bee, F. M. Cox and M. M. Gridley. Whitmore-Dean Mfg. Co., Chicago, Ill.; machinery, boilers, etc.; C. E. Whitmore, Charles R. Dean and John W. Hill.

HOWARD CARROLL, Pres. CHARLES A. STRADLER, Treas. C. S. CHAMBERLIN, Sec. HENRY BOLER, Gen. Man.

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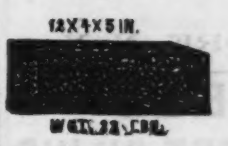

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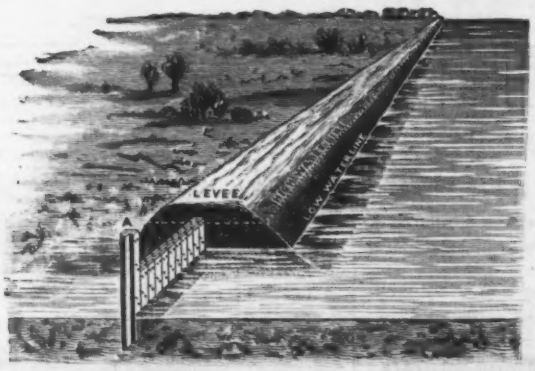

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